WATER WORKS & SEWERAGE

L. H. ENSLOW, Editor

THIS MONTH »»

How the utilitarian and aesthetic considerations in the disposal of sewage at a seashore resort were met by the construction of an underground plant is described. This mechanically operated separate digestive plant, by the way, is the only one of its type located completely below the surface of the ground. An interesting discussion on sewage treatment in the United States, based on an inspection tour during which 31 of the most up-to-date plants in the country were visited, is given by R. F. Goudey. Dr. Baylis' article in the Filtration Plant Section deals with the coagulation of water. A description of the actual accomplishments and of plant installations in the purification of water for the textile industry is given by S. B. Applebaum.

AND NEXT »»

The leading articles scheduled for the April issue include the following: "Water Supply for the Paper Industry," by L. M. Booth; "Sewage Treatment Project at Cleveland, Ohio," by Geo. B. Gascoigne; "High Lights in European Sewage Treatment Practices," by E. B. Besselievre; "Some Notes on Electrically Driven Centrifugal Pumps," by H. E. Beckwith; "Keeping Filter Beds in Condition," by John R. Baylis; "Design and Operating Features of the Activated Sludge Process," by R. F. Goudey.

Vol. LXXIX, No. 3

CONTENTS for MARCH 1932

Sewage Treatment in the United States Compared with That at Los Angeles Experimental Station 67
By R. F. GOUDEY
Sanitary Engineer, Department of Water and Power, Los Angeles, Calif.

Filtration Plant Section: Hints in the Coagulation of Water 71
By JOHN R. BAYLIS
Physical Chemist, Bureau of Engineering, Chicago, Ill.

New Water Softening Plant at Neodesha, Kan. 75
By F. M. VEATCH
Black & Veatch, Consulting Engineers, Kansas City, Mo.

Report of Meeting of New England Water Works Association 77

Report of 14th Annual Texas Water Works Short School 80

Purifying Water for the Textile Industry, Part II 83
By S. B. APPLEBAUM
Vice President, The Permutit Co., New York City.

Underground Sewage Plant Serves Spring Lake, N. J. 87
By P. N. DANIELS and C. H. CAPEN, JR.
Consulting Engineer, Trenton, N. J.; Consulting Engineer, West Orange, N. J.

Progress in Sewage Practice: A Review of Current Literature 90
By C. E. KEEFER.

Super and Dechlorination at Glencoe, Ill. 93
By E. L. PFLANZ
Superintendent of Water Works, Glencoe, Ill.

Weather Cycles and Their Causes 95
By H. P. GILLETTE

Report of Second Annual Arkansas Water Works Conference 99

Editorials 101

Published monthly by the GILLETTE PUBLISHING CO., Daily News Building, Chicago, Ill.

Entered as Second Class Matter, June 2, 1931, at the Post Office at Chicago, Ill., under the Act of March 3, 1879. Published monthly at 400 W. Madison Street, Chicago, Ill. Per copy 20c. Subscription rates $1.00 per year.

Copyright, 1931, by Gillette Publishing Company.

Publishers of: Engineering and Contracting, Water Works and Sewerage, Roads and Streets, Tiles and Tile Work, The Art of Mosaics and Terrazzo, Road and Street Catalog and Data Book, Water Works Catalog and Data Book.

HALBERT P. GILLETTE, Pres. and Editor in Chief; E. S. GILLETTE, Vice-Pres. and Secretary; E. B. HOWE, Vice-President; E. C. KELLY, Vice-President; T. F. KILROE, Vice-President; J. M. ANGELL, JR., Eastern Manager; L. H. ENSLOW, 420 Lexington Ave., New York, N. Y., Editor; C. T. MURRAY, Managing Editor; V. J. BROWN, Associate Editor; JOHN R. BAYLIS, Associate Editor; H. J. CONWAY, Make-Up Editor.

Chicago Office, Daily News Building. Cleveland Office, 952 Leader Bldg. New York Office, 420 Lexington Ave. San Francisco Office, 381 Bush St.

Addresses will be changed as frequently as desired, upon notification; not otherwise. Changes of address should be sent in at least two weeks before the date of the next issue of *Water Works and Sewerage*, in order for them to be effective for that number. Immediate notice should be given of any delay in the receipt of the magazine.

ADVERTISERS IN THIS ISSUE

A

Alvord, Burdick & Howson 16
American-Moninger Greenhouse Mfg. Co. 12

B

Black & Veatch 16
Burns & McDonnell Engr. Co. 16

C

Chester Engrs., J. N., The 16
Chicago Testing Laboratory 16
City-Waste Disposal Co. 16
Clark, Wm. G. 16
Cleveland, H. Burdett 16

D

Diamond Alkali Co. 5
Dorr Co. ..... Third Cover
Dow & Smith 16

E

Electro Bleaching Gas Co. ..... Second Cover

F

Filclor Co., The 12
Filtration Equipment Corp. 13
Fowler, Chas. Evan 16

G

Gillette Publishing Co. 14
Gordon & Zulot 16

H

Hall, B. M. & Sons 16
Hill, Nicholas S. 16
Hubbell, Hartering & Roth 16

I

Ideal Electric & Mfg. Co. 13
Industrial Chemical Sales Co., Inc. 8

J

Jennison-Wright Co., The 7

K

Kiersted, Wynkoop 16
Knowles, Inc., Morris 16

L

Lock Joint Pipe Co. 15
Lord & Burnham Co. 11

M

McWane Cast Iron Pipe Co. 6
Menantico Sand & Gravel Co. 12
Metcalf & Eddy 16

N

National Water Main Cleaning Co. 12
Neubling & Mast 16

O

Omega Mach. Co. 13

P

Pirnie, Malcolm 16
Potter, Alexander 16

R

Randolph-Perkins Co. 16
Robinson & Steinman 16

S

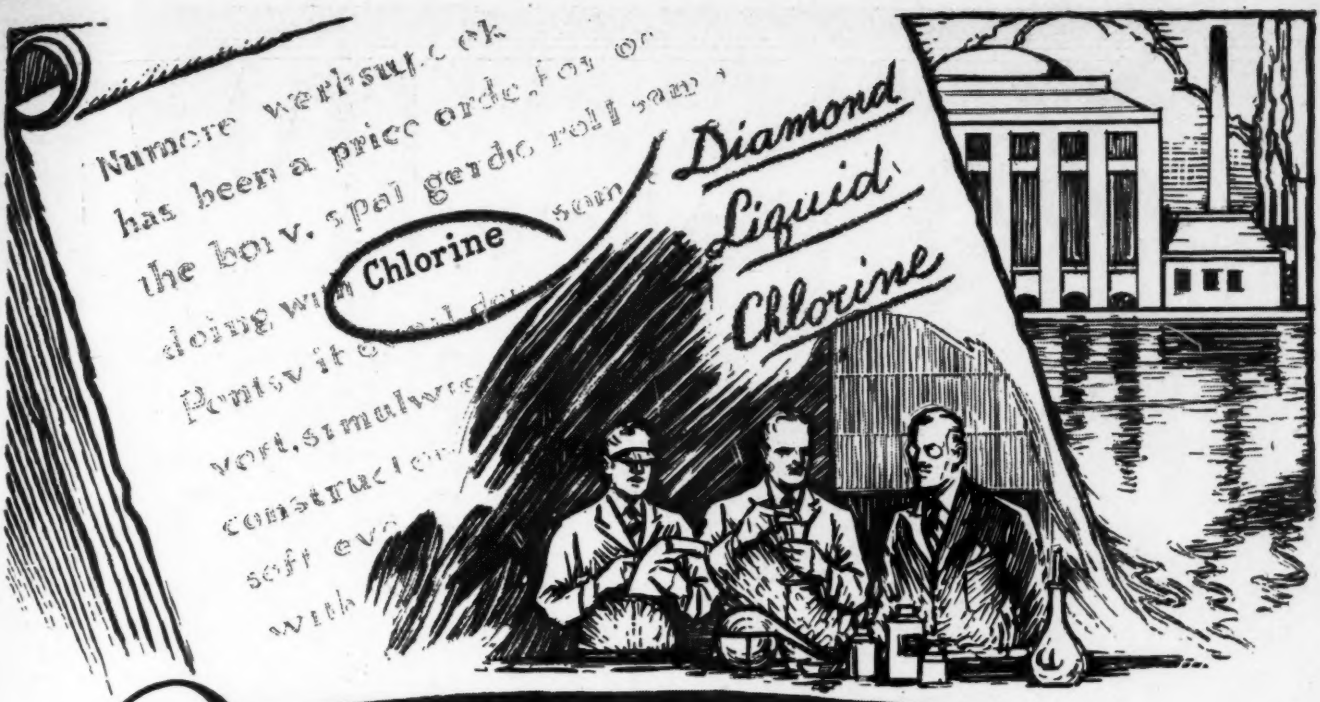
Simplex Valve & Meter Co. 13
South Bend Foundry Co. 15
Stewart, W. H. 11

T

Tamms Silica Co. 15
Taylor Audit Co., P. H. 16

W

Waddell & Hardesty 16
Wallace & Tiernan ..... Back Cover



Please *mark* that PLAINLY

Many municipal authorities are positive in their preference for DIAMOND LIQUID CHLORINE . . . they find its purity and quality constant and unvarying . . . they have learned by experience that its action against bacterial growths in public water works is one of the most powerful safeguards to public health and sanitation.

DIAMOND LIQUID CHLORINE deserves *your* confidence, too. Inquire about our quotations and delivery.

Diamond Alkali Company

Pittsburgh, Pa. *and Everywhere*

CHLORINE

DIAMOND *Liquid* CHLORINE

This makes LONG Lengths possible

McWANE PIPE is made as large as 12-inch, in 16-foot lengths. SAND-CAST yet modern. Bell & Spigot type.

in 1¼, 2 *and* 3 *inch* CAST IRON PIPE

The McWane small cast iron pipe shown here is furnished in 1¼, 2 and 3 inch sizes, with the intermediate joints male and female threaded with oversize threads.

The pipe is assembled at the factory into 15 and 18-foot laying-lengths, with these threaded joints. Thickening the pipe-wall at regular intervals, provides tapping collars, which are cast integrally with the pipe.

PIPE-LAYING SPEEDED AND SIMPLIFIED

Field joints may be any of the following three types:

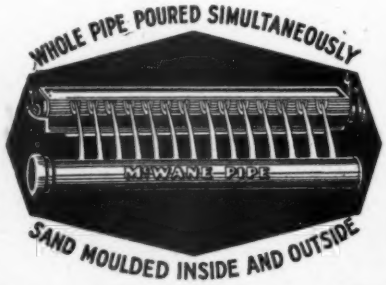
First. Male and female threaded, with oversize threads—same as the intermediate joints.

Second. Open bell and spigot for using lead or other preferred material.

Third. *Precalked* Joints, in the bells ready to *finish* on the job by simply socketing the pipe and calking—sure, positive, and simple.

High Speed and low-cost laying, no future rust or joint trouble, distinguish McWane Precalked Joint Cast Iron Pipe. Address:

McWANE CAST IRON PIPE CO. BIRMINGHAM ALABAMA



PACIFIC STATES CAST IRON PIPE CO. PROVO, UTAH

NEW YORK 40 Exchange Place | CHICAGO 208 S. LaSalle St. | KANSAS CITY 1006 Grand Ave. | LOS ANGELES 6800 S. Alameda St. | SAN FRANCISCO 111 Sutter St.

DALLAS 1807 Santa Fe Bldg. | SALT LAKE CITY 149 W. 2nd South St. | DENVER 226 Cont'l Oil Bldg. | PORTLAND, ORE. 611 Spalding Bldg.

Klearit Assures a Sweet Sparkling Water Supply

UNPLEASANT taste and odor in water are absolutely eliminated by Klearit, an activated carbon that is really active. And—just as important—use of Klearit speeds and facilitates the whole filtration and purification process.

Klearit will not clog the filter. It can be introduced at any convenient point in the filtration system and makes possible longer runs between cleanings. Klearit has the distinct advantage of being able to place more clarifying capacity in the hopper of the feeding machine at one filling.

Klearit is scientifically prepared by carbonizing under vacuum, at elevated temperature, an organic product to a carbon content of over 99%, and then properly activating to a very high degree.

Klearit being over 99% pure carbon has the unique characteristic of being both pure carbon and having very hard texture. It combines all the advantages of soft char without any of the numerous disadvantages and clogging problems of other materials.

Klearit in granular form is equally efficient for purifying water in both pressure and open type filters.

The Jennison-Wright Company

Toledo, Ohio

Branches in All Large Cities

KLEARIT

To Operators of Filtration Plants in the U. S. A. having Taste and Odor Problems

YOU *are the* JUDGE!

There will be no Appeal from your Decision in this Trial

For months you have been reading and hearing about the amazing effectiveness of Activated Carbon in removing Tastes and Odors from potable waters.

Very likely you have wondered just what this remarkable new agent could do in helping *you* overcome tastes and odors in *your* water supply.

Here is your chance to find out . . . and without risking a penny. This offer makes you the sole judge of what NUCHAR, Powdered Activated Carbon can do for *you*.

We will ship to your plant, freight charges prepaid, enough NUCHAR, to enable you to make a thorough plant test. We will send you complete detailed instructions upon how to apply it, in fact everything needed to make a convincing test which will demonstrate exactly what NUCHAR will do in *your* plant.

When that test proves satisfactory you will be billed at the standard price for the amount of NUCHAR sent, plus the freight charge. *If, for any reason, you are not convinced that NUCHAR performs satisfactorily, there will be no charge, not even for freight.*

There are no strings or conditions to this offer. YOU will be the sole judge and we will abide by your decision.

We will send you a brief questionnaire . . . eight simple questions in all. Your answers to these will enable us to tell you how best to apply NUCHAR to your system. Simply sign the coupon now and and send it in. Industrial Chemical Sales Company, Inc., 230 Park Avenue, New York . . . or 205 W. Wacker Drive, Chicago.

83

Industrial Chemical Sales Co., Inc.
230 Park Avenue, New York, or 205 W. Wacker Drive, Chicago.

We operate a FILTRATION Plant and want to take advantage of your Trial Offer of NUCHAR, Powdered Activated Carbon. Send along your brief questionnaire. We will fill in the answers and return it promptly.

Name of Company.....

Address.....

.....

Name of Individual.....

The amazingly successful results which have attracted so much attention in the Water Works field have been achieved with

ACTIVATED CARBON

Be sure you specify a product which has proven itself efficient.

WATER WORKS AND SEWERAGE

MAR. 1932

VOL. 79 No. 3

A GILLETTE PUBLICATION

SEWAGE TREATMENT IN UNITED STATES—

COMPARED WITH THAT AT LOS ANGELES EXPERIMENTAL STATION

By R. F. GOUDEY

Sanitary Engineer,
Department of Water and Power,
Los Angeles, Calif.

PART I

R. F. Goudey

THE Los Angeles Department of Water and Power has, since May 12, 1930, been continuously operating a 200,000 gallon per day complete activated separate-sludge-digestion plant with one-third of the effluent being filtered in a complete water purification plant.

An inspection tour, for the purpose of learning of new methods worked out at Eastern plants which might be incorporated in our experimental program and, at the same time, to compare performance of other plants with what has been accomplished here, was made by Dr. Carl Wilson, Director of Sanitation of this department, and the writer. A total of thirty-one of the most up-to-date sewage plants in the country were visited as the result of instructions from H. A. Van Norman, General Manager and Chief Engineer of the department.

The itinerary included four sedimentation and separate sludge digestion plants featuring Grand Rapids, Mich., ten sprinkling filter plants of which Alliance and Cleveland South Side Plant excelled, the direct oxidation plant at Winston-Salem, North Carolina, and sixteen activated sludge plants of which Rockville Center, Elyria, and Peoria were the best examples.

Principal Points of Difference Eastern Versus California Sewage Treatment

Designing engineers in Southern California have made a mistake by following eastern research results without taking into consideration distinctive differences in sewage characteristics. Southern California sewage, devoid of grit and storm water, runs two to three times higher in total solids and biochemical oxygen demand values than eastern sewage treated at the plants visited. [Peoria sewage is an exception to the rule.] The ratio of volatile solids to total solids is also higher. Sewage temperatures, both average and maximum, are 10 degrees higher in California than sewage in the middle west; and is 25 degrees above that of sewage along the North Atlantic Coast. Dissolved solids from the more highly mineralized California water supplies increase the problem of sewage disposal. Accordingly, the sewage here is more concentrated, sludges are more liquid, potential power from sludge digestion is greater, the sewage becomes septic before treatment plants are reached, and biological activity instead of being confined to the usual nitrogen changes involves also the sulphur and carbon cycles. These several complications show why research recently inaugurated in California must be more inclusive than similar work elsewhere if plants to be constructed here are to be most efficiently designed.

In Southern California there is a greater public demand that sewage treatment plants be designed to prevent creation of nuisances and further that certainty of continued treatment of the degree required for each installation be guaranteed. Outside of California, "getting by" with zero factors of safety and frequent

Sewage Treatment Plant of Alliance, O.; Imhoff Tanks and Sprinkling Filters

uses of "by-passes" is prevalent practice. This has arisen because of the almost universal availability of dilution water and the general prevalence of low standards for water supplies in their raw state. Excusable, perhaps, during seasons of average rainfall, the viciousness of this policy is seen in all its nakedness during periods of drouth when water treatment processes, inadequate to produce hygienically safe water from streams containing practically untreated sewage, become factors in the spread of intestinal diseases. One river we were told, has its water reused twenty-one times to the point where its high temperature and filth prevented its further usefulness. In four other cases, streams which ordinarily could accept raw sewage without jeopardy to water supplies below, reached such low stages that their flow had to be used over five successive times. No such crude methods of sewage reclamation are being considered for Southern California. Sewage treatment, instead, is more and more being put on a business basis and a sensible method acceptable to psychological objectors will eventually be worked out.

It was saddening to find good chemists with exquisite laboratories and the best of operation facilities zealously compiling elaborate and, for the most part, useless records without any thought of improving operation or changing the design of future units. It was refreshing to find operators at some of the smaller plants competent to make simple tests and use their heads in interpreting results.

The east is very slow in adopting new applications of mechanical devices. For instance, paddle aeration definitely established over 1½ years ago has not been incorporated in any plant. Chlorination, so advantageous as an integral part of activated sludge control, is practiced at no eastern plant and only four of the plants visited used chlorine for functions, other than disinfection. In California practically every high grade treatment plant is equipped with chlorinators. Many plants in the east violate the first principle of mechanicalizing sewage treatment by complicating piping and valve connections. The unnecessary maze of valves and piping at two plants visited was a nightmare greatly increasing installation cost just for sake of saving extra pumps. The use of mechanical equipment is justified when better results can be obtained more cheaply and simply.

Status of Sprinkling Filters

Very little progress has been made during the past 15 years in sprinkling filter treatment. The use of mechanical clarifiers for secondary sedimentation and glass covered sand beds for drying of sludge appear to be the only new innovations in general acceptance. Of ten sprinkling filter plants visited, eight were equipped with mechanical clarifiers, and seven were of the Dorr type. The basis of design varies from 1200-1500 gallons per square foot of settling tank area per day. Effluents from them are in general very poor for the reason that these settling rates based on average flow are seldom obtained. In actual practice the flow is very intermittent due to the functioning of the dosing tanks and the emptying of flooded beds. Plants operating at rates of 600-800 gallons per square foot per day because of their actual flow being much less than their designed flow were giving fairly good removals, but the need of equalizing or smoothing out the flow to the clarifier even in these cases was apparent.

Glass covered sludge beds were found at all but one sprinkling filter plant. Their maintenance and insurance costs are high but they give safer operation. Practically all the beds were designed on a basis of three persons per square foot which has proven to be totally inadequate. Most plants have resorted to extra open beds which operators prefer to use in good drying weather. A recognized desirable basis of design for covered beds is 1.5 persons per square foot. At Marion, O., wet sludge is applied at a rate to give a uniform application of dry solids for each bed regardless of whether the depth of wet sludge is 8 in. or 15 in. This is a more logical method of operating all types of sand beds rather than arbitrarily running out the sludge to a depth of 12 in. regardless of its solid content.

Sludge was being marketed for fertilizer at only one sprinkling filter plant visited. At Marion a very unique method is employed. Sludge dried to about 30 per cent in the covered beds is removed to another covered bed where it is piled up to almost the roof. It is naturally dried to 10 per cent moisture, ground, sacked, and sold under the trade name of "Humusite" for $15 per ton. The nitrogen analysis is given as 3.5 per cent.

Nuisance from the filter fly Psychoda still persists, although it has been somewhat minimized at the expense

of the effluent by flooding the beds one day a week followed by a day's rest. Plants which have mechanical clarifiers, and which have blindly copied the flooding practice, drain flooded filters through the clarifiers at flushing rates. Flooding of filters cause these units to unload more uniformly throughout the year, impairing the appearance of the effluent which ordinarily at times might be better. Flooding of beds at Canton, O., cuts out two-sevenths of the plant capacity and causes overloading of the remainder of the plant by just that amount.

The use of slag at Canton for filter material appears successful. Employing a cap layer of granite over limestone rock, as at Alliance, justifies that combination where limestone is logical to use in part. Filter rates seem to be increasing. At Cleveland the rate is 4,000 persons per acre foot and this is beyond question too high, not only for Cleveland but elsewhere in the east, and most certainly in Southern California.

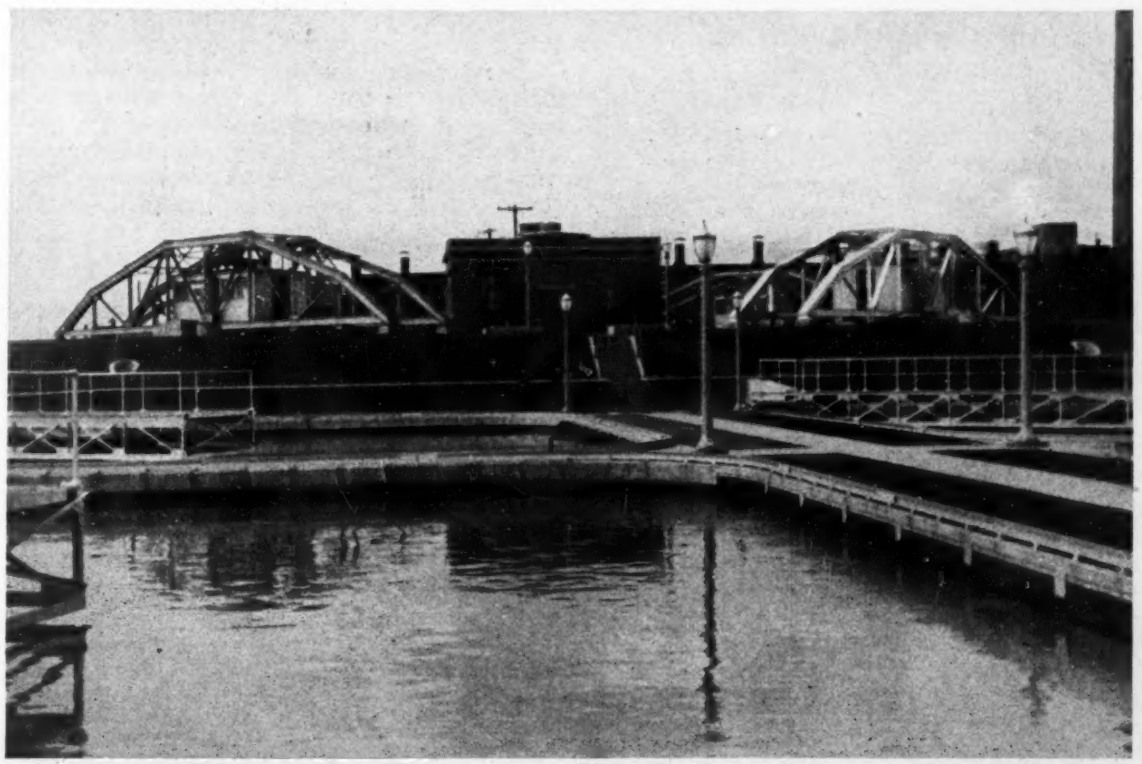
Just why separate sludge digestion has not replaced Imhoff tanks in sprinkling filter treatment is difficult to understand. Baltimore, long ago swung over to separate sludge digestion and it has long since been employed at Plainfield, Hartford and elsewhere. Except for Aurora, Ill., which is a good example of what can be done with separate sludge digestion with sprinkling filters, and the conversion of several small plants from Imhoff tanks to separate sludge digestion plants ahead of filters, such as Fostoria, O., and Grand Island, Neb., but few others have made the change. The largest and supposedly most modern sprinkling filter plants, such as those at Akron, O., and the Cleveland South Side Plant, hark back to Imhoff tanks with attending troubles.

The most serious indictment against the sprinkling filter plants is that the cost of installation is high when considering the results secured. At plants of large capacity, it can be shown that the installation cost for separate sludge digestion is about $25,000 per million gallons per day capacity. The activated sludge process requires $35,000 per million gallons per day capacity additional. A sprinkling filter plant will cost $75,000 per million gallons capacity more than a separate sludge digestion plant, about twice that for activated sludge. Corresponding operation costs are: Separate sludge digestion $5.00 per million gallons; activated sludge $10.00 per million gallons more; and sprinkling filter treatment $5.00 per million gallons more than separate sludge digestion.

The capitalizing of the slightly increased operation cost of the activated process over the sprinkling filter process is less than the increased installation cost of the sprinkling filter over the activated sludge process. The quality of sprinkling filter effluents, however, does not compare to the degree of treatment produced by the activated sludge process. The averages of the annual average suspended solids and biochemical oxygen demand tests from six sprinkling filter plants in the east are 35 p.pm. and 38 p.p.m. respectively. Similar averages from seven activated sludge plants give suspended solids 23 p.p.m. and oxygen demand of 18 p.p.m. The two processes are no longer comparable. The activated sludge process is a notch higher and the sprinkling filter effluent is but little better than a good clarified effluent.

From the standpoint of cost for the very little additional improvement in the final effluents, sprinkling filters are in many cases not justified. For instance, with a sewage of 100 p.p.m. suspended solids the separate sludge digestion process will produce an effluent with about 15 p.p.m. less solids and 20 p.p.m. less oxygen demand at one-fourth the installation cost and one-half the operation cost of sprinkling filters.

The force of the argument is even stronger when a raw sewage with a suspended solid content of 400 p.p.m. and an oxygen demand of 350 p.p.m. is considered. The sprinkling filter has an advantage of only 20 per cent over the separate digestion process, whereas the activated sludge process is over 75 per cent better. In other words, the separate sludge digestion process, particularly where settling rates of 600 gallons per square foot per day are employed, gives too small a



Sewage Treatment Plant of Grand Rapids, Mich.; Plain Sedimentation and Separate Sludge Digestion

margin between it and the sprinkling filter process to justify the huge difference in cost.

A most serious criticism of the sprinkling filter process is the entire lack of any chance to control the type or characteristics of the purifying agencies. In an activated sludge process (although this is practiced only at our Griffith Park Experimental Plant) the activated sludge can be removed, conditioned, diluted, concentrated, altered and adjusted to suit the changing character of the sewage or condition of the plant, whereas a sick sprinkling filter plant is not amenable to controlled treatment and must wait for Nature to effect a long time natural cure. The larger area which the filters must have over the activated sludge process, the inability to control spray odors, fly nuisance, and filter unloading and absence of streams to cover up inadequacies of treatment, militates against the successful use of the sprinkling filter method of treatment in Southern California.

The Direct Oxidation Process

Close scrutiny was given to the direct oxidation plant at Winston-Salem, N. C., where the screened sewage, after liming, is subjected to electrical-ozone treatment and sedimentation before being discharged into a small stream. The sludge after thickening is dewatered on vacuum filter equipment. The process resolves itself into one of sterilization by excess lime, partial coagulation with thorough mixing of lime, particularly in the electrolyzers, and getting a fairly good chemically settled effluent with suspended solids of 65 p.p.m. and an oxygen demand of 54 p.p.m. The inhibition of lime holds down putrescence of organic material until adequate stream dilution is afforded. The cost of operation is about $24.00 per million gallons.

Although the installation ideally fits their soft water sewage and stream dilution available, it does not appear suitable for Southern California. Factors against its use here are, first, the high alkalinity of the sewage which would require much heavier doses of lime; second, the degree of treatment which it affords can be obtained by other means at less cost; and, third, a limed sludge would be valueless as a fertilizer, to such extent that all costs of sludge operations would be lost.

Supremacy of the Activated Sludge Process

The adaptation of the separate sludge digestion process to the activated sludge method of treatment has provided the means of solving the hitherto difficult problem of sludge disposal, making it economical for both large and small installations. The theory behind the older plants, and also the new one at Tenefly, N. J., that raw sewage is needed in the aeration tanks to maintain a good condition of activated sludge has now been fully exploded. When no preliminary clarification is provided all of the sewage solids become converted into a dilute sludge of 99.5 per cent water, amounting in volume to about 50,000 gallons for each million gallons of sewage treated. With efficient sedimentation all of the solids, including waste activated sludge, after being pumped at a low rate to the incoming sewage are diverted with about the same moisture content as raw sludge and amounting in volume to one-tenth of that which the sludge would occupy if no preliminary clarification were employed. This sludge is still further reduced in volume and in solid content by digestion after which it is readily dewatered and made available for marketable fertilizer. Gas generated in the digestion process can be used to develop power. Such are the important new developments in the activated sludge process.

Activated sludge plants of small capacity are now in the ascendency. Nine out of the sixteen plants visited were of capacities less than five million gallons per day and two were less than one million gallons per day capacity. The cost of operation for these small but modern plants is less than the older and larger plants. In fact, the cost of operation for the new plants is distinctly on the downward trend. The cost of operation for the Salem, O., plant, treating 800,000 gallons per day, is given as $38.00 per million gallons. Rockville Center and Elyria plants cost $20.00 and $30.00 per million gallons, respectively, to operate. All of these figures are below estimates of what would be allowed for plants of similar capacity in California and correspond to an operation cost of less than $15.00 per million gallons for a large plant.

Industrial wastes are no longer a bug-a-boo except where reasonable care is not given to oxygen requirements or hydrogen ion concentration. At Peoria is found the best eastern example of what can be done by the activated sludge process in treating sewage with heavy industrial wastes in that adequate attention is given to aeration periods and oxygen requirements. The difficulties at the new sprinkling filter plant at Akron, O., which has to cope with industrial wastes is one of the strongest silent arguments for activated sludge treatment. Had it been adopted at Akron flexibility and opportunity to adjust the plant would have been procurable.

The fact that all large sewage treatment plants are of the activated sludge type cannot be lightly set aside. The sprinkling filter plant at Baltimore, with a capacity of 60 m.g.d., was, for a long time, the largest high grade plant in the country. It still is the largest sprinkling filter plant. Yet, since its time, all plants of larger capacity have been activated sludge plants. For instance, Milwaukee has built a 110 m.g.d. plant, Chicago at North Side a 175 m.g.d. treatment works, and New York at Ward's Island now has under construction a 180 m.g.d. plant. Chicago has recently changed the proposed plans for a 450 m.g.d. sprinkling filter plant at West Side in favor of an activated sludge plant.

The activated sludge process is receiving more and more favor because the degree of treatment is far superior to that obtained by the sprinkling filter method. As crude as most of the activated sludge plants are, the effluents from them as determined from yearly analyses carry less than one-half of the suspended solids and oxygen demand values than the average of all the sprinkling filters visited. At our Griffith Park Station, where research has carried the process further than has been developed elsewhere, the effluent carries less than one-half the suspended solids and one-fourth of the oxygen demand values of the average of the activated sludge effluents produced in the eastern plants visited. The surprising point is that this superior treatment deals with a very strong industrial sewage and the cost of operation, based on estimates for a plant with a capacity of 25 m.g.d., is less than $15.00 per million gallons. It is in the making of such showings as this that research such as is conducted at the Griffith Park Station is justified and should be continued.

Editor's Note:—In a subsequent issue of WATER WORKS AND SEWERAGE, Mr. Goudey will discuss "Design and Operating Features of the Activated Sludge Process" in which he will cover the shortcomings, possible improvements and operating costs of the activated sludge process as revealed at the Los Angeles Experimental Station and elsewhere.

FILTRATION PLANTS

A Section Dealing with Their Design, Construction and Operation

Conducted by JOHN R. BAYLIS, Associate Editor
Physical Chemist, Bureau of Engineering, Chicago, Ill.

◆

HINTS IN THE COAGULATION OF WATER

CONDITIONS occasionally arise in most every filtration plant which require unusual measures to produce satisfactory water. Usually it is not difficult for the experienced operator to handle varying conditions of the water when everything is working all right, yet there is no plant where everything works all right all the time. When troubles arise the operator may not able to refer to a set of instructions, to some article in a technical journal, or to some book that will tell him what to do. Then he has to rely upon his own ingenuity as to what should be done. There are many instances where the operators have been able to correct or improve bad conditions to the extent that satisfactory water is supplied the consumers all the time, even under very difficult circumstances.

The cause of the trouble may be some unusual condition of the water before treatment, to a breakdown or overloading of the equipment for feeding chemicals into the water, to an accident in the mixing basin requiring it to be by-passed, to insufficient mixing time, to some trouble in the settling basins, to the necessity of having one settling basin out of service for cleaning and little or no settling in the other basin, to trouble in the filter beds, to a breakdown of the filter washing equipment, or to other causes. At many plants the writer has visited the operators relate how they have handled some unusual condition, how they have corrected some defect in the design of the plant or equipment, how they have kept the plant in operation when a serious accident occurred, or how they made some simple change in the operation which resulted in increased efficiency of the plant. Occasionally we find an article describing what the operator did to handle some unusual condition, or what he did to overcome some obstacle, yet such articles are very few. It is believed that the various filter plant operators have used many useful means of improving conditions in their plants which have not as yet been described in articles.

More Practical Hints Needed.—It is the purpose of this article to relate or describe a few of the unusual things in the coagulation of water which have come to the attention of the writer. It is hoped that it will inspire the readers to forward to the writer brief descriptions of how they have handled some difficult situation. If the device or change has improved your condition it may be of aid to others. Your method of handling some difficult situation might be just the thing for handling a similar situation in some other plant. Let us put on record a sufficient number of instances where the operator, by resorting to his own ingenuity, has overcome troubles in the filtration plant, so there will be scarcely a condition which may arise that has not been published.

Type of Employees an Important Factor.—The most desirable filter plant operator is a person who studies his plant conditions and the equipment so that he knows fairly well what variable character of water the plant will be called upon to handle, what treatment is best for each kind of water, and the limitations of the plant and the various pieces of equipment in the plant.

Some Operators Become Skillful in Judging the Quality of the Coagulation.—The ease with which some operators turn out a good quality of water all the time is remarkable. The writer recalls visiting a filtration plant of several million gallons daily capacity a number of years ago, and his amazement at what was found. The water was obtained from a small river and probably varied in turbidity from about 20 to 10,000. The plant had no mixing basin and not a very large settling basin. If his memory is correct, there was no meter on the in-coming water, and no chemical feeding device other than one or two small chemical solution tanks. The settling basin was operated on the fill and draw plan, except it was drawn down only 2 or 3 ft. before again being filled.

The operator would open the influent valve and let in a full flow of water. Presumably he knew from previous experience about what the rate of flow would be. He observed the appearance of the water for turbidity, and set the chemical solution valve so as to get a flow of the solution which he knew from previous experience would coagulate the water. When the settling basin was filled nearly full he would cut off the water and the chemical solution. The raw water was quite turbid at the time of my visit. The operator was asked how much aluminum sulfate he was adding, and he replied that he did not know. He was then asked if he could clear water by operating in this manner. The writer was invited to look at the clear water reservoir. The water was about 16 or 18 ft. deep in the reservoir, and there would have been no difficulty in seeing a pin on the bottom. If it is possible to produce water of zero turbidity, this water was of that quality.

Presumably the night operator in this plant followed the same procedure as the day operator. Inquiry was made to several of the citizens of the city if their water was satisfactory all the time, and their reply was that they had the best water in the country. This is a case where the operators used little ingenuity in controlling the operation of the plant, but had studied the characterisics of the water so thoroughly they could produce, by methods which were extremely crude, perfectly clear water all the time with little effort on their part.

Very likely they were wasteful of chemicals, but they had learned the lesson that the water must be clear all the time to prevent complaints, and their operation could be called successful, for the public cares very little about how results are accomplished just so long as the water is good all the time.

Many of the filter plant operators years ago would have almost felt insulted if someone had suggested that they use certain tests as a means of determining whether or not the water was coagulated perfectly instead of merely looking at the effluent of the mixing basin or at the "break" in the settling basins. Observations at these points is the main method in judging the quality of the coagulation in many plants today and is the only method that many operators will ever use. There is not very much in the literature on water treatment telling how to judge by appearance when the water is properly coagulated. Operators frequently remark that they can tell if the water is coagulated sufficiently merely by observation but that they cannot explain to someone else just how the distinction is made. If someone could clearly define how this is done it would be of great aid to many who are training to be filter plant operators. Experience seems to be the best teacher in this instance.

Judging the Quality of the Coagulation.—The writer will attempt to define his method of judging coagulated water when it is not desired to go to the trouble of actually filtering some of the water. It is admitted that the explanation is not a very good one. First, a sample of water is collected from the effluent of the mixing basin, usually in a breaker or jar, taking care not to break up the flocculation. It is examined by holding between the eyes and a window or other light. It should show well formed particles of flocculated matter. The water between the particles should not be cloudy but should look perfectly clear. Particles of the flocculated matter should show almost as distinctly within the solution some distance from the near side of the breaker or jar as they do close to the side next to the observer.

If a highly turbid water is properly coagulated, most of the flocculated matter will settle to the bottom of the breaker or flask within 5 to 10 minutes. Usually it will settle to such clearness that the particles of flocculated matter remaining in suspension may be observed throughout the liquid when a one-liter breaker or jar is used. If the water is so cloudy after 10 minutes' settling that the particles of flocculation farthest from the eyes cannot be detected, or are only faintly visible, the water very likely will not filter clear. The writer places more reliance upon the ease with which particles some distance from the near side of the breaker or flask may be detected than anything else. Filtering the water through a coarse well washed filter paper is a very good way of determining if it has been properly coagulated.

Observation of the water in the settling basins is another very good way of predicting if the water will filter clear. Most filter plant operators can observe the water in the settling basins near the entrance ends and predict very closely how it will filter. If clear streaks of water form at the surface, and the coagulated water after traveling a short distance appears to drop underneath water that is almost perfectly clear, that is another indication that it will filter clear. A submarine or vapor proof light fastened to the end of a rod or pipe 5 to 10 ft. long with flexible cord so that the operator may move it about and stick it under the water a few inches is a very good way of judging the coagulation, especially in the night and in places not exposed to the outside light. The appearance of the floc passing through a beam of light thrown into the basin is another good indicator.

Where the Water Flows Out of the Settling Basin Is a Very Good Place to Judge the Quality of the Coagulation.—Where the water flows over a baffle at the outlet of the settling basin, or over a baffle from one basin to another, is a very good place for observing the coagulation in daylight. Where the settling basins are not covered this is usually the most convenient point of judging the quality of the coagulation. The disadvantage is that it is usually several hours after the chemicals are applied before the water reaches the outlet of the settling basins. In localities where the settling basins have to be covered to prevent freezing there may be no place where the operator can carefully observe the coagulation either in the mixing basin or in the settling basins. This makes it more difficult to keep the coagulation perfect all the time.

Some of the plants with open settling basins have a building wall along the ends of the basins that extends 1.5 to 3 ft. below the water surface to prevent cold air from entering the building. The inlet and out ends of the basins are within the building several feet and serve as good points for observation.

At plants where it is not possible to observe the coagulation at the outlet of the mixing basin or within the settling basins, an excess of the coagulant probably is used most of the time. The operator will not run on a very close margin of chemicals for fear of occasionally having cloudy filtered water. Designing engineers should take this into account in future designs. The saving in chemicals very likely will greatly overbalance the cost of placing the roof a little higher over at least part of the mixing and settling basins. The average employee in a filtration plant would prefer to observe the coagulation in a settling basin five times an hour than to collect and carefully observe one sample per hour in a breaker. There is something fascinating or attractive about watching well coagulated turbid water "break" and settle out in a settling basin. It is not difficult to get operators to keep a fairly close watch on the appearance of the water in the settling basins if the basins are so arranged that they may be easily observed.

Solution Feeds in Many Plants Almost a Constant Source of Trouble.—Back in the days when nearly all filtration plants used solution tanks for chemicals and fed the solution into the water through an orifice, many troubles developed and kept the operators constantly in fear of the water not being perfectly coagulated. Many of these solution tanks are now being abandoned for dry feeding apparatus with improvement in the operation, and it is believed that most of the plants, especially the smaller plants, could change to dry feeding apparatus with profit. It is very easy to argue if a definite weight of chemical is dissolved in a definite volume of water, and the solution is fed into the water through an orifice with a certain size opening and a constant head is maintained on the orifice that the application of the chemical to the water will be uniform and exactly in the proportion desired. To accomplish all this is not an easy task.

The writer has operated solution tanks, both large and small, and there are many things which give trouble. The operator may weigh the quantity of coagulent desired, place it in the dissolving box, dissolve and run it into the solution tank, fill the tank to the required depth to get a certain strength solution, and a few minutes before it is time to start using the solu-

tion he turns on the switch or valve to start the agitator which mixes the solution only to find that something is out of order. He may be able to take a paddle and mix the solution by hand, yet if the tank is fairly deep the chances are it will not be thoroughly mixed. This will result in the solution being stronger than desired when the tank is first started and weaker when the tank is nearly empty. Some may say that it is carelessness to allow such a thing to happen, but when there are other troubles to which attention has to be given there probably is no operator who does not occasionally use an improperly mixed tank of chemical solution.

Chemical Feeding Boxes Sometimes Give Trouble.—The chemical feeding boxes are a source of considerable trouble in some plants. Small chips, splinters of wood, pieces of paper, and other materials get into the float valves and cause variations in the head of water on the orifice. The variation may be detected within a short time by a careful operator, yet insufficient coagulant for a period of 10 minutes may cause cloudy water to pass through the filters if means of applying secondary doses of the coagulant are not provided. The orifices in the feeding boxes gradually wear and calibrations made at one time may be off considerably six months afterwards. Wear on the float valve may reach the point where the flow of the solution cannot be cut as low as is desired, and this will cause the solution to maintain a higher level when the flow is low than when it is at an average flow or higher. This causes an unequal proportioning of the chemical.

Chemical Feed Lines Become Clogged.—All chemical feed lines become clogged and need occasional flushing or cleaning. When a high pressure of water is available and proper blow-off connections have been provided it may be possible to keep the lines cleaned by flushing. Usually the operator does not realize that the chemical lines are becoming clogged until a sudden change in the water necessitates the use of more chemicals, then it is found that sufficient solution cannot be fed through the lines. By the time the lines are flushed or cleaned by other means, or by the time a stronger solution can be prepared, considerable water may be inadequately treated. Much of the chemical feeding equipment now being installed has sufficient duplication of feeding devices, chemical lines, blow-offs, easily repaired valves, etc., to insure fairly constant application of the chemical solutions. This was not the case in many plants years ago. Valves in chemical solution lines almost invariably leak after a short use, and a type of valve that may be easily reseated should be used.

We are beginning to realize more and more the desirability of having short chemical solution lines, and are locating the solution and orifice tanks as near to where the chemicals are to be added to the water as possible. In a few plants open troughs are used where there is a gravity flow. If the solution has to be added to a pipe or conduit under 15 or 20 ft. head of water, almost invariably there is trouble from air getting into the line and occasionally causing an overflow of the solution at the orifice box.

Dry Feed Machines Less Subject to Trouble.—Dry feed machines are by no means free from trouble, but usually there are not so many things about the machines operating under conditions which makes the parts subject to frequent interference as is the case with solution feeds. There, of course, are dry feed machines which are not suitable for the chemicals they have to handle, and some are not designed along lines that insure constant proportioning of the chemicals, but most of these machines on the market can be relied upon to give very good results. If the machine as constructed gives trouble the operator sometimes can make minor changes in it that will overcome the trouble.

As an illustration of some of the things that may be done to improve the operation of a dry feed machine, Mr. Prindle of the Highland Park, Ill., filtration plant placed a piece of glass on the sliding part of a Municipal Equipment Company's machine and materially reduced the caking of alum on the slide. He also placed baffles in the dissolving box of the same machine and prevented undissolved alum accumulating in the dissolving box. Most every one operating dry feed machines has had trouble with the coagulant caking on the feeding part of the machine to the extent that the accuracy of the machine was affected, and many have had trouble with the chemical not being thoroughly dissolved in the dissolving box.

Another operator recently told the writer that he added an attachment to a dry feed machine which increased its capacity nearly twice the original capacity. He was suddenly confronted with the need of adding a certain chemical to the water in excess of the capacity of the machine and had no other equipment available for use. Very likely a number of operators have made changes in their dry feed machines which have resulted in increasing the accuracy of the machine, or have made them less subject to interference.

Improving the Coagulation.—There are several instances where the insertion of obstructions in the mixing basin to increase the agitation of the water has improved the flocculation. The writer inserted boards about 8 in. wide and 10 to 12 ft. long flatways across the line of flow in the first section of the mixing basin at Baltimore, and there appeared to be improved coagulation as a result of the increased agitation. Some of the mixing basins are now being constructed so there is considerably greater violence of agitation in the first part of the basin than in the latter part. There is evidence that the coagulation is better than if the agitation is the same throughout the basin. This may be true only for waters difficult to coagulate. The importance of keeping the pH of the water within the range necessary for good coagulation is so well recognized that this cannot now be offered as a hint in the coagulation of water. It is an essential for efficient operation at many plants.

The value of prolonged mixing at the right violence of agitation for producing good flocculation is now generally recognized. Twenty years ago some of the leading filtration engineers did not believe that mixing of more than 1 to 5 minutes was desirable for many waters. Data recently collected on the mixing time in a number of filtration plants throughout the country showed that there are a number of plants having a mixing time less than 5 minutes. A mixing basin was not constructed in the filtration plant at Jackson, Miss., when it was first constructed. Results were poor, and the addition of baffles in the first part of one of the settling basins to provide about 5 minutes mixing cut the cost of chemicals for coagulation nearly one-half. It also resulted in an improved product being delivered to the mains. The saving in the chemical cost was over $1,000 annually, and the mixing basin cost less than $100. When the plant was extended some years later a more pretentious basin was constructed. It is very gratifying to see the increasing number of laboratory stirring machines being used. It is an indication that the operators are giving more thought to coagulation.

An Unusual Experience With Highly Turbid Water.—An unusual experience in handling water of high turbidity in a large filtration plant some years ago is recalled. The turbidity of the raw water increased to about 5,000, which was very high for this plant. Alum and lime were being used to treat the water, enough lime being added to maintain an alkalinity of about 10 to 15. The water was coagulated perfectly in the mixing basin, and when a sample was collected in a breaker most of the flocculated matter would settle out within a few minutes. When the water entered the two settling basins over baffles it dropped downward almost immediately as though it was considerably heavier than the clear water. It flowed along near the bottom of the settling basins to the outlets of the basins where it came up and passed over the outlet baffles with a turbidity in excess of 1,000 and water of that turbidity applied to the filters will not filter clear.

The water on top in these settling basins was fairly clear, but flowed in the reverse direction of the way it should be traveling. A surface float would travel to the entrance end of the basin instead of to the outlet end. In one of the basins a stream of water from a fire hose was directed so that it struck the surface of the water about 50 ft. from the entrance end in a manner to impart as much forward motion to the water as possible. This caused the direction of the surface water to change and flow towards the outlet of the basin. The turbidity of the effluent from this basin dropped low enough for the filters to produce a clear product. Nothing was done to the other basin and the effluent continued turbid with considerable coagulated matter passing the filters supplied by that basin. It was definitely shown that the lack of settlement in the basins was due to a high velocity near the bottom of the basins which created an overturning of the water in the upper part, and that by preventing this overturning the trouble would be corrected.

Perhaps little of practical value has been given in the present article. It is written more with the hope that it will encourage others to relate some of their experiences than to give very much specific information. Think over your past experiences and see if you can recollect something that may be of value to others.*

Seven New York Cities Have New Filter Plants

Seven new water filtration plants were constructed or put into operation during 1931 in New York State.

The largest of these plants is for the new Albany water supply.

New rapid sand filters were built at Attica, Wyoming county, to replace obsolete and inefficient equipment. New filtration plants at Madrid, St. Lawrence county, and at Orchard Park, Erie county, are also replacements.

Abandonment of the Hudson River as a source of water supply by the village of Catskill, Greene county, and the construction of a filtration plant on an upland supply are important advances in the protection of the public health of the village.

For the first time in its history the city of Lockport, Niagara county, has been furnished with filtered water. All of the cities and villages taking water from the Niagara river now have filtration plants. Ossining, Westchester county, also used filtered water in 1931 for the first time.

*Ed. Note: Water Works and Sewerage invites you to submit short articles covering operating problems and your method of overcoming it. Helpful hints in operation will be read and appreciated by many.

Indiana Section—A.W.W.* Met at Purdue March 9 and 10

The Indiana Section of the A. W. W. A. held its 25th Annual Meeting at Purdue University, Lafayette, Indiana, on March 9th and 10th.

An interesting feature was the holding of a special session for water purification plant operators in addition to the general sessions.

The General Session on March 9th opened with the Round Table covering the following Distribution Problems:

1. Adequate Inspection of Valves and Hydrants.....W. H. Durbin
   Discussion led by.....F. T. Schultz
2. Effective Control of Meter Reading.....L. D. Shively
   Discussion led by.....C. B. Yobst
3. How Meters Are Damaged.....Charles Streithof
   Discussion led by.....C. W. Winkle

Afternoon General Session—March 9th

The Water Utility's Responsibility for Public Fire Protection.....Clarence Goldsmith
Savings Effected Through the Installation of Private Fire Protection.....R. H. Burdick
Discussion led by.....J. B. Marvin
New Regulations Regarding Cross Connections with Private Supplies.....L. S. Finch
Discussion led by.....H. E. Jordan
Remote Control of Elevated Water Storage.....Homer Rupard
Demonstration of Chlorinator Maintenance

Water Purification Session, March 9th
(10 A. M. to 4 P. M.)

The Water Purification Process.....Professor R. B. Wiley
The Definition of a Satisfactory Water.....H. E. Jordan
Filter Sand Maintenance.....Frank W. Herring
Demonstrations of Routine Control Tests for Controlling Chemical Dosage.....Elliott H. Parks
Determination of Turbidity of Filtered Water.....Neil Kershaw
The Control of Chlorination.....Clarence D. Adams
The Interpretation and Application of Laboratory Results to Purification Plant Operation.....Paul J. Cerny
Round Table Discussion of Operating Problems

A Dinner Meeting at 6:30 P. M., March 9th, was addressed by Dr. J. A. Estey of Purdue University on the subject "Stabilization of Industry and Employment."

General Session—March 10th

Dangers to Well Supplies.....J. C. Mathews
The Public Health Aspects of Current Economic Conditions.....Dr. W. F. King
The Water Plant Manager and His Community.....F. P. Stradling
Discussion led by.....C. S. Chamberlin
Tuning in on Your Customer.....Miss Mary Symms
Discussion led by.....C. C. Foutz
Pressure Losses in Customers' Services.....J. A. Bruhn and H. W. Niemeyer
Discussion led by.....W. L. Younce

At the Luncheon Meeting on March 10th, Frank C. Jordan, of the Indianapolis Water Company, spoke on "Twenty-Five Years in Retrospect."

C. K. Calvert, 1902 N. New Jersey Ave., Indianapolis, is Secretary of the Indiana Section.

L. S. Finch of Indianapolis presided as President.

*Ed. Note: At time of going to press the Indiana Section was in session and the above account is taken from the program only.

NEW WATER SOFTENING PLANT AT NEODESHA, KANSAS

By F. M. VEATCH
Black and Veatch,
Consulting Engineers,
Kansas City, Mo.

PURSUANT to a popular demand for soft water, very emphatically shown at the polls in November, 1930, the city of Neodesha has completed a new and up-to-date water softening plant, to replace one of the pioneer filter plants in Kansas, built in 1907.

This southeastern Kansas city of 3,200 people has been unusually progressive in the matter of public improvements. The water, gas and electric utilities are municipally owned, the city is well paved and has an extensive sewer system and modern sewage disposal plant.

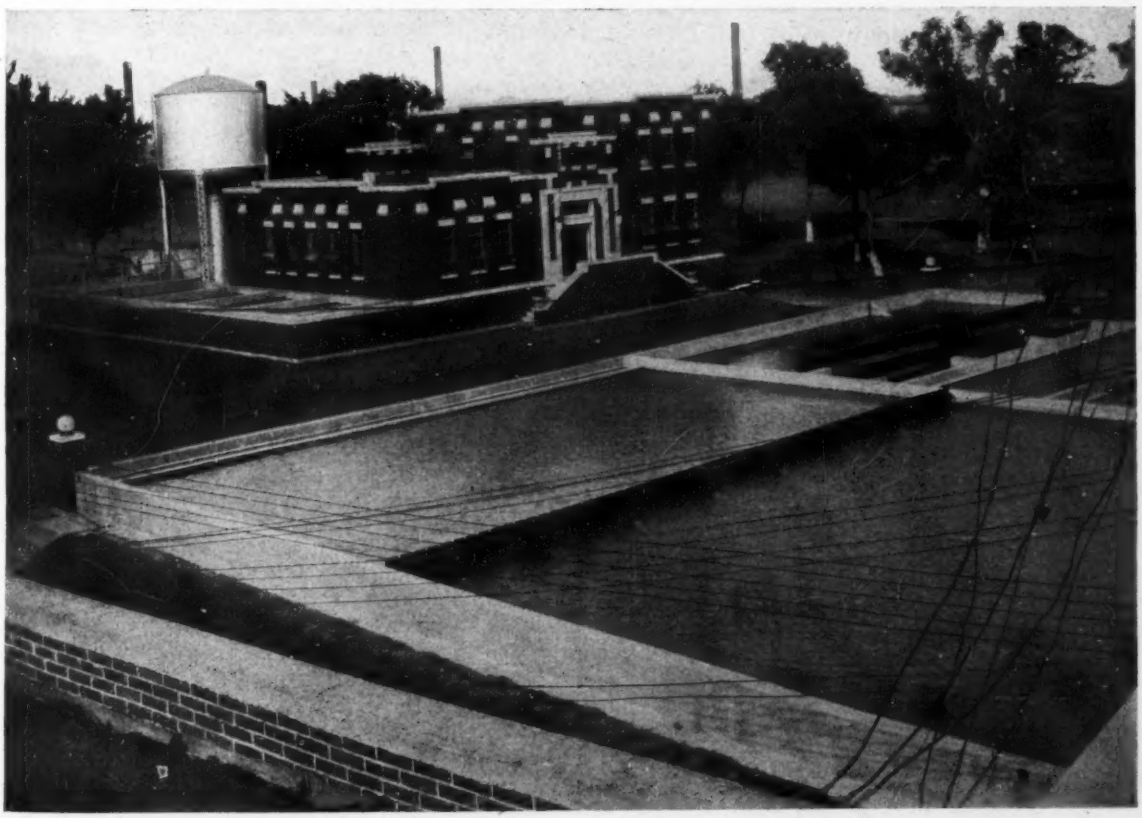
Water Supply.—The water supply of Neodesha is taken from the Fall River, a short distance above its confluence with the Verdigris, and since the water varies quite widely, both as regards turbidity and hardness, an interesting treatment problem is presented. During the spring and summer months the turbidity will range from 200 to 5,000 parts per million, and the total hardness will vary from 100 to 200 parts per million (6 to 12 grains per gallon); but during the fall and winter months when the stream is fed from springs, rather than from surface run off, the turbidity is low and the total hardness may reach 350 parts per million, or approximately 20 grains per gallon.

In addition to the matters of hardness and turbidity, the occurrence of tastes and odors are mainly those common to small streams, but at times phenol tastes from refinery drainage are experienced.

Water Softening Plant.—The water softening plant has been designed to treat 2,000,000 gal. of water per day, since the normal city consumption is increased by the demand of two railroads and has been made extremely flexible in order to meet the varying condition of raw water. Provision has been made for the use of alum, lime, soda ash, chlorine, ammonium sulfate and carbon dioxide, and a well equipped laboratory has been provided to permit the necessary control tests to be made.

Mixing Tank and Aerator.—The mixing tank is hopper bottomed and holds 10 minutes flow. Combined mixing and aeration is effected by compressed air applied through perforated brass pipes laid on the tank bottom. This tank is located within the building and immediately below the chemical feeding machines, in order to eliminate long chemical lines.

Clarifier.—In order to facilitate the removal of the heavy sludge from the softening process as well as the grit which is encountered at times of high turbidity, a settling tank, or clarifier, with a capacity of one hour flow and fitted with mechanical scrapers for sludge removal has been provided. Sludge is siphoned off either



New Water Softening Plant of Neodesha, Kan.; Capacity 2,000,000 Gal. Daily; Cost $65,000

continuously, or at intervals, by means of adjustable sludge outlets.

Settling Tank.—The existing settling basins have been remodeled and hold approximately 12 hours flow. A stilling baffle has been inserted in the first compartment, and the second compartment has been baffled to provide a recarbonation chamber, a mixing channel for alum, and a final settling basin.

Filters.—The filter plant consists of two hydraulically operated filter units, each with a capacity of 1,000,000 gal. per day. These are of conventional design throughout, and discharge into a 200,000 gal. clearwell, which is, in reality, the original filter plant, fitted with a concrete cover slab and covered with earth. Filter wash water is stored in a 40,000 gal. elevated steel tank, located at the rear of the filters.

Chemical Building.—A fireproof brick building has been constructed to house the chemical feeding equipment, the filters, the laboratory and the auxiliary plant equipment. The upper story is reserved for chemical storage, and a loading deck and hydraulic elevator are provided to facilitate the handling of chemicals. This floor is fitted with tight doors to prevent the spreading of dust. The main floor of the building is taken up by the filter operating room, the office, and the chemical feeding room. The pipe gallery, filter cells, mixing basin, blower room and laboratory are housed in the lower, or ground level, floor.

Recarbonator.—Carbon dioxide for use in the softening process is obtained by the combustion of natural gas, and after being washed, cooled and passed over a bed of limestone, this gas is compressed in a rotary compressor and introduced into the water through a grid of perforated pipes set near the bottom of the inlet end of the recarbonation chamber. The production of carbon-dioxide is regulated by a manometer and control valve on the gas supply line.

Chemical Feeding Equipment.—All chemicals, with the exception of chlorine and carbon-dioxide, are fed through dry feed machines, of which two are fitted with slakers to permit the use of crushed quicklime, and are suspended on dial scales to permit a ready check on the discharge. A third machine of similar type, but without a slaker, is mounted on a platform scale and is intended for use with pulverized alum. These three machines are located on the top of the mixing tank and have hoppers, which extend into the chemical storage room for charging. The alum machine is fitted with a double discharge, one of which leads directly into the mixing tank and the other into the baffled channel at the outlet end of the recarbonation chamber. A fourth dry feed machine, of the rotary type, has been provided for use with ammonium sulfate, and discharges into the outlet of the recarbonation chamber. Chlorine is applied into the filter effluent line just before it enters the clear well.

General.—This plant is provided with the customary facilities to combat turbidity, hardness, taste, odor, and bacterial pollution, all of which are factors in the treatment of this particular raw water. It is intended to reduce the hardness of the water from an average of approximately 250 parts per million to an average of 100 parts per million, and at the same time to render the water clear, tasteless, odorless and bacterially safe. The plant has not been in operation long enough to make actual cost records available, but based on the quality of the raw water indicated by casual analyses made over a period of several years, the cost of this treatment will average slightly less than 1.25 ct. per 1,000 gal., exclusive of fixed charges.

This plant was constructed by the Standard Paving Co. of Tulsa, Okla., at a cost of approximately $65,000. It was designed and supervised by Black & Veatch of Kansas City, Mo., and will be operated under the direction of F. K. Vance, Superintendent of the Water and Light Department.

The work of J. W. Bogue, Mayor, and B. H. Hill, Commissioner of Utilities, in managing the many details incident to the realization of this project is an outstanding example of unselfish municipal service.

Editor's Note:—Since the writing of the above paper reports have been received from the city authorities at Neodesho indicating a monthly saving in soap and washing powder bills of between 75 cents and $1.00 per month per family. They report also that the consumers have been well pleased with the softer water even at the increase in rates made necessary—the minimum being $1.75 per month.

▼

Fertilizer Base from Sewage Sludge

By C. G. WIGLEY, M. AM. SOC. C. E.
Consulting Engineer, Atlantic City, N. J.

Successful production of a fertilizer material from sewage sludge has been developed recently at Atlantic City, N. J.

During the past year the capacity of the small experimental unit has been unable to meet the demand for the finished material.

This is the second year in which the sludge fertilizer has been sold on a commercial scale. The first year was one of introduction of the new output and in many instances free samples were given to the prospective customer. The second year has demonstrated the value of this form of procedure.

Prices for which the bagged fertilizer is sold are unbelievably high to engineers and operators of sewage plants. There are given below the quantities and prices of the various classes of fertilizer sold by the South Jersey Plant Food Co. during the year 1931:

	Per Ton
11 tons coarse ground sludge fertilizer	$20.00
65 tons finely ground fertilizer	35.00
6 tons special 5-9-4 fertilizer (sludge base)	90.00

It will be noted that there are three classes of fertilizer. The coarse ground material is for ploughing or spading into the soil for new lawns, vegetable or flower gardens of some size. The finely ground fertilizer is used on existing lawns and flower gardens, or potted or hot house plants. The third or special class of fertilizer is sold to florists and nurserymen requiring a well rounded out fertilizer, rich in nitrogen, potash, and phosphorus for general use.

Most of the sales of fertilizer have been made to nurseries, cemeteries, and municipalities for park purposes, and the demand is steadily increasing. To meet the increasing demand steps are being taken to increase the plant production of fertilizer.

The fertilizer base is manufactured from the sewage sludge in Atlantic City, as removed from the sewage settling tanks and sludge beds, using a process discovered a short time ago, in which the ordinary fungus molds are utilized to convert the sludge into a stable inodorous fertilizer base.

At the Atlantic City plant, the undigested sludge from the sewage settling tanks is utilized. The same process may be applied to sludge digested or undigested from Oliver filters or similar appliances, or activated sludge dried upon sludge beds.

NEW ENGLAND WATER WORKS ASSOCIATION ADDRESSED BY ENGLISH CHEMIST

APPROXIMATELY 140 members of the New England Water Works Association gathered on Feb. 9 at a luncheon meeting in Boston to hear an address by a distinguished guest—**John T. Calvert** of London, England, on the subject **"American and English Water Works Practice—Random Impressions of an English Chemist."**

Mr. Calvert, by way of introduction, is the son of Dr. Calvert, Chief Engineer of the British Ministry of Health, and is in America taking graduate courses in Sanitary Engineering at the Massachusetts Institute of Technology and Harvard. He has had an opportunity to visit most of the important water works and sewage plants in America.

In visiting American plants, Mr. Calvert said, that he had been impressed with the considerable attention paid to efficient mixing of chemicals, the extent of use of mechanical equipment throughout the plants and also the prevalent use of remote control equipment in operating pumps, gates, valves, etc. All of this was quite different from the usual practices in England. There they used more hand labor in both sewage and water plants.

He referred to the long standing English practice of water purification through the use of slow sand type filters but that all recent installations of filters had been of the rapid sand (American) type. Where rapid filters had been used previously, they were used without coagulation and acted as "scrubbers" or prefilters ahead of the customary slow sand units, and had assisted the slow filters materially.

In water softening, Mr. Calvert had found that America was much more advanced than England. There, little or no softening of municipal supplies had been practiced, leaving softening to the manufacturing establishments and laundries. He had been impressed with America's large softening plants, particularly so with one plant serving a city of 20,000 people. There the water was first lime softened and then a predetermined portion is passed through Zeolite filters to be thereafter mixed with the lime softened product in predetermined ratios to produce a finished water of any desired degree of softness.

Mr. Calvert commented on the very interesting American development of procesess for controlling tastes and odors in water supplies, the most popular being the use of ammonia and activated carbon. Further, he had been considerably interested in sewage reclamation as practiced at Grand Canyon, Arizona, and at the Los Angeles experimental sewage treatment plant. Results of these plants had shown the high degree of treatment that was possible.

In England they had to depend a great deal on large storage reservoirs for water supply. In some cases these lay alongside of a river covering large areas. They were mostly of shallow construction, consisting of a dyke paralleling a stream for some distance. The recently completed Queen Mary reservoir on the London supply holding 6.5 billion gallons was of that type.

Mr. Calvert, of course, mentioned the low per capita water consumption in England as compared to that in America as being one of the outstanding differences when making comparison of practice in the two countries.

E. Sherman Chase, in discussion, referred to the earliest sand filters as being those installed at Chelsea, England, in 1829, and recalled the lead taken in the early use of chlorination at Lincoln, England, in 1904 under Dr. Houston's supervision as perhaps outstanding English contributions to water works practice. His observation had been that rapid sand filters used in municipal practice in England had been employed only as strainers without coagulation. He referred to one English plant (Southend Water Company) that softened its water and recovered the lime by burning the precipitated calciums carbonate sludge to lime which was re-used. Since the lime available for that practice was necessarily about twice the requirement—inasmuch as 1 lb. of lime added to hard water produces sufficient carbonate to produce almost 2 lbs. of lime when burned—this plant had been selling excess lime to farmers. Also, said Mr. Chase, this plant had been using powdered activated carbon applied to the water going into the filters, at the time of his recent visit, and with good effect in taste removal.

(**Editor's Comment:** At the Southend Company's plant lime recovery is a necessity, rather than an economy, the lagooned sludge is burned to lime because the overall cost of that practice is cheaper than other practices which would be required to prevent stream pollution by the sludge discharged.)

Robert Spurr Weston, for 30 years a member of the association, spoke of the once ample value of storage reservoirs in safeguarding water supplies, but remarked that the present day use of automobiles rendered more prevalent the usage of watersheds, artificial purification by chlorination, filtration or both was becoming more important than ever before. He believed that in small towns a modified type of slow-sand filters would prove the most practical purification device to employ—they being dependable and requiring very little in the way of careful operation. He suggested the use of slow-sand filters operated at twice or more the usual slow-sand rates of filtration. He believed the labor of cleaning the beds could be supplied from the various city departments without added cost to the municipality.

In connection with a taste problem, he has recently employed powdered activated carbon at one filter plant, using a dosage of 4 lb. to the million gallons, with success. The satisfactory results and low cost made the procedure a very attractive one. His experience with ammoniation had shown that in some instances the taste trouble had not been corrected.

Mr. Weston said that English water-taking practice required frequently the return of compensation water to the stream by the taker during dry periods. He asked for some comment on the practice and requirements.

Mr. Chase commented on the situation at one point where the Bradford Water Company had been required to build large reservoirs to store compensa-

tion water and that these had then been required to be turned over to the West Riding Rivers Board for operation.

Arthur L. Shaw, member of the firm of Metcalf and Eddy, during a trip to England learned that there had been established through precedent an empirical figure for compensation water which had almost the standing of Parlimentary Law in England at this time. The prevailing requirements called for the maintenance of flows in the streams to the extent of one-third the normal flow of an average year. In other words, compensation water had to be supplied by takers whenever the stream flow dropped below 33 per cent of normal volume and that this was frequently felt to be an unwarranted requirement. Some action was under way to get that changed. Mr. Shaw also spoke of the very barren watershed above Bradford. He understood that altitude had had something to do with failure of young trees to live when planted there.

Referring to the lesser per capita water consumption in England than America, Mr. Shaw thought that the very careful inspection of water fixtures of all kinds in the shops of the English water works might have considerable bearing on the matter. No fixtures were allowed to be used until they had passed through the shop test and received the water company stamp of approval. Certainly by that procedure waste through leaking fixtures would be reduced materially.

Prof. Gordon Fair, in answer to a request for some remarks, said that he had not been so favorably impressed with the quality of water served in most English municipalities. It lacked clarity and sparkle and was not cold. England had many attractions to the American visitor but among the first he could not rank its water or water works systems.

L. H. Enslow thought that Mr. Calvert had been almost too modest in his remarks concerning English water works practice. The use of activated carbon had been referred to as an American idea, but it so happened that water had been subjected to purification through rapid sand filters containing sand gravel and granular carbon, as the final cleanser, by an English filter manufacturer at least 20 years ago. Among other things it was shown that the carbon had acted as a dechlorinizer as well as taste remover and purifier. Like chlorination, however, the use of carbon did not progress to any marked extent in water treatment until it was exploited in America.

Mr. Calvert rose to express his appreciation for the very hospitable treatment he had received at the hands of American water and sewage works men and stated that he had been highly impressed with all that he had seen—this as the result of their willingness to show him all that there was to be shown, which was indeed appreciated.

"Politics and the Water Works Superintendent"

The next speaker on the program was **W. A. Hardenbergh,** who spoke concerning the relationship of politics to the personnel of water works. He mentioned the several aspects of political interference with water works management, programs of improvements and even operation at times. Such interference and changes demanded in operating personnal of water works had often been costly, and frequently detrimental if not actually dangerous. He warned that water works superintendents should avoid political entanglements. By making the consumers believe in him, by "delivering the goods," by joining and attending the meetings of technical associations, by reading water works literature and technical magazines and, most important, by refraining from taking a vigorous part in pre-election work this could be done. If politicians send him men to hire use them, but with warning that it is a case of "trial for fitness" and not a "soft job" that is being given the appointee. If the appointee does not come up to requirements then ask the political sponser for his transfer to a more suitable place.

Mr. Hardenbergh thought that there was both "good and bad" in civil service arrangements. The preferential position now given ex-service men frequently meant that better fitted men were not available anywhere near the top of the list of eligibles which had to be chosen from. He also discussed the possibility of insuring the permanency of water works positions by the passage of state licensing laws or something of a similar nature which would require that responsible positions be filled only by licensed superintendents and operators. Committees in technical associations could do much good by working on plans whereby the management of water works might be removed from political interference. He thought nowdays water works superintendents and managers would be expected to continue to improve their qualifications by more study, and that short schools in colleges and universities should be arranged for water works superintendents.

Reports from members telling of political displacements of capable men, brought forth the desired discussion as to what might be done to remedy the existing situation. In the end the chairman was instructed, by motion carried, to appoint a committee to study ways and means of placing water works superintendents on a more secure footing by preventing political interference.

Superintendent Stephen Taylor, of New Bedford, Mass., recommended that the committee confer with state health departments in New England before making its final recommendations to the association.

Superintendent Roger W. Estey, of Danvers, Mass., spoke in favor of legislation and some form of a licensing system. He pointed out also that 35 to 40 per cent of the municipalities in the New England States with water works were still not represented in the association and that a drive should be made to bring representation from these municipalities into the association.

Warren J. Scott, Chief Engineer, Connecticut State Department of Health, said that the majority of the water works in Connecticut were company owned and operated. He pointed out the danger of having licensed men (not subject to removal) in municipally owned water works jobs because of the dissatisfaction that might spring up between a non-removable licensee and the city administration, resulting in endless friction and decreased efficiency. He felt that the state health department should not go beyond stipulations that if a licensed man was to be removed that another be installed with the provision that the latter should meet certain prescribed requirements as to knowledge and fitness.

Superintendent David A. Heffernan, of Milford, Mass., said that he felt the need of some sort of law to safeguard superintendents because after 42 years of service he saw the possibility of one politician getting into a position which would place him in grave danger of dismissal.

Superintendent W. H. Vaughan, of Everett, Mass., stated that he was protected by state civil service regulations which his city had accepted and that he felt sure that other cities could avail themselves of this act if they wished to do so. Apparently not many had taken the step.

Frank J. Gifford, Manager of Water Works at Dedham and also secretary of the association, closed the discussion by stating that he believed the superintendents were unduly alarmed and that there could be found a means of ample protection if it appeared that more protection was needed.

Those Present at the Meeting

Ackley, Fred R., Water Works, Nashua, N. H.
Ackley, R. W., Gamon Meter Co., Newark, N. J.
Arnold, V. E., Phoenix Meter Corp., New York City.
Allan, M. C., Builders' Iron Foundry Co., Providence, R. I.
Abbott, E. P., Crane Company, Boston, Mass.
Babbitt, Frederick E., Somerset, Mass.
Ball, S. T., Edson Mfg. Co., So. Boston, Mass.
Baron, F. L., E. L. Baron Foundry Co., Brockton, Mass.
Belknap, Harry, Boston, Mass.
Benson, S. Alfred, Public Works Dept., Town Hall, Arlington, Mass.
Beach, T. M., W. Springfield, Mass.
Bengle, V. N., Chapman Valve Co., Indian Orchard, Mass.
Boardman, Nelson, Water Works, Danvers, Mass.
Brehm, George C., Waltham, Mass.
Briggs, Silas L., Supt. Onset Water Co., Onset, Mass.
Brown, C. L., Rensselaer Valve Co., Northboro, Mass.
Caldwell, Geo. A., Geo. A. Caldwell Co., Boston, Mass.
Calvert, John T., London, England.
Callahan, N. J., Lawrence, Mass.
Case, E. D., The Pitometer Co., New York City.
Chase, Sherman E., Metcalf & Eddy, Boston, Mass.
Chase, John C., The Benjamin Chase Co., Derry, N. H.
Classon, W. Guy, Leominster Water Works, Leominster, Mass.
Conners, J. B., Boston, Mass.
Crowell, H. B., Rensselaer Valve Co., Haverhill, Mass.
Crowell, Herbert C., Supt. Water Works, Worcester, Mass.
Coulters, A. B., Builders' Iron Foundry Co., Providence, R. I.
Dickinson, Mr., Boston, Mass.
Danaby, John, Hopkinton, Mass.
Dionne, Elisha, Water Department, Salem, Mass.
Doane, A. O., Metropolitan Dist. Comm. Water Div., Boston, Mass
Duffy, William B., Supt. Board of Public Works, North Andover, Mass.
Dwyer, Thos. E., Lead Lined Pipe Co., Wakefield, Mass.
Eddy, Harrison P., Jr., Metcalf & Eddy, Boston, Mass.
Ellis, Richard H., Water Commr., West Newton, Mass.
Ellis L. S., Great Pond Road, North Andover, Mass.
Emerson, Frank, Lowell, Mass.
Enslow, L. H., Water Works and Sewerage, New York City.
Esty, Roger W., Supt. Water Works, Danvers, Mass.
Fair, Gordon M., Harvard University, Cambridge, Mass.
Ferguson, R. E., Hersey Mfg. Company, So. Boston, Mass.
Fitzsimmons, J. V., Kennedy Valve Company, Elmira, N. Y.
Fox, Benj. E., Water Commr., West Springfield, Mass.
French, Clarence B., Civil Engr., Water Department, Waltham, Mass.
Gafney, J. H., A. M. Byers Co., Boston, Mass.
Gear, Patrick, Supt. Holyoke Water Department, Holyoke, Mass.
Gidley, Henry T., Supt. Fairhaven Water Co., Fairhaven, Mass.
Gifford, Frank E., Supt. Water Works, Abington, Mass.
Goodale, H. J., Supt. Water Department, Middleborough, Mass.
Goodale, Leon A., Water Commr., Worcester, Mass.
Godfrey, Chas. L., Perrin, Seamans Co., Boston, Mass.
Goodnough, X. H., Boston, Mass.
Halpin, Henry E., Boston, Mass.
Hanscom, Hervey A., Hydraulic Development Corp., Boston, Mass.
Hardenbergh, Wm. A., Public Works Journal, New York City.
Hancock, Robert T., Lawrence, Mass.
Hazard, T. G., Jr., Mgr. Wakefield Water Co., Narragansett Pier, Rhode Island.
Heffernan, D. A., Supt. Water Service, Milton, Mass.
Harrison, Samuel, Boston, Mass.
Hatch, Walter M., Supt. Water Works, Whitman, Mass.
Hayes, R. F., Hydraulic Development Corp., Boston, Mass.
Hersey, F. P., Hersey Mfg. Co., South Boston, Mass.
Hart, C. G., Wallace & Tiernan, Boston, Mass.
Herlihy, Michael J., Newton Water Department, Newtonville, Mass.
Hill, James G., Supt. Water Works, Lowell, Mass.
Hill, Chester A., Badger Meter Co., New York City.
Hayes, J. H., Hayes Pumps & Mach. Co., Boston, Mass.
Haas, Chas. G., Mueller Company, New York City.
Howe, E. C., Cement Lined Pipe Co., Lynn, Mass.
Hopkins, E. C., Pres. Crystal Water Co., Worcester, Mass.
Hough, Laurence C., Pitometer Company, Boston, Mass.
Howard, John L., Deputy Chief Engr., Metropolitan Dist. Comm., Boston, Mass.
Hoy, Joseph A., Worcester Water Department, Worcester, Mass.
Howard, E. P., Turbine Equipment Co., Boston, Mass.
Hughes, Edward F., Water Commr., Watertown, Mass.
Hughes, E. F., Jr., Watertown, Mass.
Hughes, Henry F., Supt. Water and Sewer Department, Medford, Mass.
Jacobs, H. W., Cement Lined Pipe Co., Lynn, Mass.
Kelly, P. E., Leadite Co., Philadelphia, Pa.
Kelly, R. L., Union Water Meter Company, Worcester, Mass.
King, Howard M., Supt. Springfield Water Department, Springfield, Mass.
King, George A., Supt. Water Works, Taunton, Mass.
King, Arthur C., Asst. Supt. Water Works, Taunton, Mass.
Kingsbury, Francis H., Mass. Dept. of Public Health, Boston, Mass.
Lumbert, William J., Supt. Water Works, Scituate, Mass.
Lufkin, J. G., National Meter Co., Boston, Mass.
Macdonald, Roger W., City Engr., Peabody, Mass.
McNulty, J. F., Chapman Valve Company, Boston, Mass.
Morse, Frank P., City Engr., Salem, Mass.
Milliken, John J., Boston, Mass.
Mowry, Charles W., Boston, Mass.
Murphy, J. A., Pittsburgh-Des Moines Co., New York City.
Naylor, William, Supt. Water Department, Maynard, Mass.
Newman, Wilfred L., Supt. Water Company, Dedham, Mass.
Northrop, Frank L., Allston, Mass.
Nolan, J. W., Somerset, Mass.
Northrop, Guy C., Hydraulic Development Corp., New York City.
O'Brein, Joseph L., Water Commr., Holyoke, Mass.
Otis, D. K., Union Water Meter Co., Worcester, Mass.
Peck, H. F., Eureka Pipe Company, Lynn, Mass.
Pratt, Gilbert H., Wallace and Tiernan Co., Newark, N. J.
Prescott, H. R., Eddy Valve Co., Worcester, Mass.
Read, Albert W., Supt. Water Department, Bangor, Me.
Replogle, H. L., Warren Foundry & Pipe Co., Boston, Mass.
Riley, John J., A. M. Beyers Company, Boston, Mass.
Ross, Albert A., Supt. Water and Sewer Department, Lexington, Mass.
Sanders, Percy R., Supt. Water Works, Concord, N. H.
Sawyer, Albert L., Water Registrar, Haverhill, Mass.
Scott, Warren J., Hartford, Conn.
Shaw, Arthur L., Metcalf & Eddy, Boston, Mass.
Snow, Bayard F., Henry Goodnough, Inc., Boston, Mass.
Smith, R. H., National Meter Co., Boston, Mass.
Stebbins, O. H., F. A. Houdlette & Co., Boston, Mass.
Simon, R. M., R. D. Wood & Co., Boston, Mass.
Shead, E. M., Arlington, Mass.
Sullivan, John F., Supt. Water Department, Chicopee, Mass.
Sullivan, Joseph F., Water Commr., Hopkinton, Mass.
Smith, J. Herman, Hersey Manufacturing Co., So. Boston, Mass.
Stein, R. E., Quincy, Mass.
Taylor, Stephen H., Supt. Water Works, New Bedford, Mass.
Thorpe, Lewis D., Boston, Mass.
Titcomb, E. J., Water Commr., Rochdale, Mass.
Taylor, A. R., Ludlow Valve Mfg. Co., Boston, Mass.
Vaughan, Brenton W., Supt. Water Department, Everett, Mass.
Voye, Vernon J., Brown Wales Co., Boston, Mass.
Weston, Arthur D., Chief Engr., State Dept. of Health, Boston, Mass.
Weston, Robert Spurr, Weston & Sampson, Cons. Engr., Boston, Mass.
Wetherbee, Wilfred J., Water Department, Gardner, Mass.
Wells, Frank F., Mueller Brass Co., Decatur, Ill.
Wilkinson, J. W., Warren Pipe Company, Boston, Mass.
Weston, H. L., Red Head Manufacturing Co., Boston, Mass.
Wickwire, J. W., Edson Manufacturing Co., So. Boston, Mass.

▼

New York Short School for Sewage Works Operators

The New York State Sewage Works Association announces that its second short school for sewage works operators, arranged for in cooperation with the New York State Department of Health and Cornell University, will be held at Ithaca, N. Y., April 4-9.

The purpose of this short school is to offer intensive training in the fundamentals of sewage disposal and in sewage plant operation by means of lectures, demonstrations, individual laboratory work and discussion.

The short course will extend over a period of one week, classes being scheduled daily from 9 to 12 in the morning and 1:30 to 5 in the afternoon. In general the morning sessions will be devoted to lectures and discussions on the principles of sewage treatment and their practical application, including the relation of design to function of treatment plants and details of operation and maintenance.

The afternoon sessions will be devoted largely to laboratory work in the bacteriology and chemistry of sewage disposal. Time will be devoted also to the interpretation of results and the preparation and analysis of sewage works operation reports.

One afternoon will be devoted to the subject of Hydraulic Measurements with demonstrations in the splendid Hydraulics Laboratory of Cornell University.

The registration fee is $10.00 and application may be made to A. S. Bedell, Secretary, of the N. Y. S. W. A., c/o State Department of Health at Albany, N. Y.

Prof. Earle B. Phelps of Columbia University is Director of the School and Prof. C. L. Walker of Cornell University is Associate Director.

▼

KALAMAZOO, MICH., TO HAVE A 7,000,000 GAL. RESERVOIR.—The estimated cost of the project is $210,000—60 to 70 per cent of which will be for labor required,—which is expected to help the unemployment situation. Bids were received in February.

V. M. Ehlers, Chief Engineer, Texas State Department of Health

FOURTEENTH ANNUAL TEXAS WATER WORKS SHORT SCHOOL

UNDER the auspices of the Texas Section—Southwest Water Works Association, the 14th Annual Texas Water Works Short School was held from January 18 to 21 at the Baker Hotel, Mineral Wells, Tex.

This year there was a departure from customary handling of the Texas School and the meeting was a typical water works association meeting with about 150 attending. The absence of V. M. Ehlers, State Sanitary Engineer and Secretary of the School, was felt keenly and expressions of regret were transmitted to him in Houston where he is recovering from a major operation. "Vic" Ehlers organized the Texas Short School and has been its guiding hand for fourteen years.

Mayor Charlton Brown of Mineral Wells delivered the customary welcome to which L. A. Grimes, Superintendent of Water Works at Abilene, as President of the section, responded.

Dr. A. H. Flickwir, Director of Public Health, Fort Worth, spoke briefly on the relation of city health departments to water supplies—going into the matters of prevention of disease transmission and the part a safe satisfactory public water supply plays in the health conditions of a community. **Rex J. Elmore,** Central Power and Light Company, San Antonio, presented the matter of "Selling the Water Utility to the Public" and **Herman Anderson** of the Vogt Manufacturing Company of Louisville, Ky., presented the claims of "Aeromix"—the low head gravity-flow mixer and aerator. **R. H. Frash** of the Fort Worth Laboratories prepared a paper relating to exterior pipe destruction by electrolysis, indicating the necessity of adequate pipe coating to prevent pitting where soil resistivity is low. **F. B. Porter** of the Fort Worth Laboratories read the paper in Mr. Frash's absence.

Dr. A. H. Douglas of the city water department, of Wichita Falls, presented a paper on **"The Ammonia-Chlorine Treatment of Water,"** citing local experiences with the method. **J. C. Montgomery,** Chief Engineer, Layne-Texas Company of Houston, outlined **"The Relative Usefulness of the Various Types of Well Water Pumps"**—covering centrifugal, turbine, air-lift and piston types. **M. L. Whitney** of Dallas spoke briefly on **"Methods Employed to Determine Efficiency of Centrifugal Pumping Units."**

Sewers and Sewage Treatment

Clyde C. Hays, City Chemist of Waco, Tex., presented a paper describing a recent development in sewage disposal which has been experimentally successful at Waco. The process consists of a three stage operation. The first is plain sedimentation for 1 hour (with separate sludge digestion), then the second is the passage of settled sewage upward through tile contact beds, assisted by diffused air—then secondary settling followed by the third stage through a stone unit similar to the contact unit of the second stage. The whole process requires 6 hours—2 hours and 20 minutes aeration in both series; 45 minutes contact with "slime producing" organisms; 1 hour and 40 minutes in contact with stone and nitrogen producing organisms. About 2 hours' sedimentation is used in 3 stages. Mr. Hays states that the upward flow assisted by diffused air prevents clogging of the contact beds. Claims made for the process are: Reduced air volumes and at lower pressures than activated sludge (1.8 cu. ft. air at 2.6 lb. against 6 to 7 lb.); high rates (15 m.g. acre day); no loss of head through plant; simple operation and results slightly better than activated sludge plant resuls. Seven weeks' trial indicates a B.O.D. reduction of 94 per cent and a 93 per cent removal of suspended solids. Flexibility sufficient to handle loads of creamery or industrial wastes is claimed. The process is essentially sedimentation and aerated contact bed treatment. All sludges are digested in separate digestion units.

J. W. Porter of the Penniman Concrete Company, Dallas, presented a paper dealing with **"Safe Depths for Sewer Pipes,"** stressing the need for the engineer to know the characteristics of his conduit and then having a competent field resident engineer to see that the specifications are adhered to. A.S.C.E. specifications were mentioned and the desirability of using concrete cradling for high loads was discussed. Mr. Porter said that by use of such cradles much heavier loading could be allowed.

H. E. Schlenz of the Pacific Flush Tank Company, Chicago gave an interesting and instructive paper on **"Sludge Digestion"** citing various plant results and practices. He stated that precautions must be taken not to carry the process too far or a slow drying sludge would result. Satisfactory digestion was had at pH values 6.8 to 7.2 and at temperatures of 77 to 83 deg. F. Mr. Schlenz stated that 90 deg. F. gave the greatest gas production and that high temperature did not cause a change in the composition of the gas formed. About 40-day digestion was indicated as the economical limit. In a discussion **P. J. A. Zeller** of the Research Station at Texas A. & M. College, indicated that digestion was ended when gasification ceased and that while sludge might be stored after this time it soon deteriorated. He differed with Mr. Schlenz by stating that the

CO_2 content of the gas increased at higher digestion temperatures.

W. S. Mahlie, City Chemist, Fort Worth, spoke on **"The Treatment and Disposal of Supernatant Liquid from Separate Sludge Digestion Tanks."** He said that disposal by dosing on sand beds had not proven successful. Objections to adding this slow settling highly putrescible material to incoming sewage were discussed. The use of chlorine at 20 p.p.m. was suggested as in Fort Worth the chlorine demand of the supernatant liquor was found to be relatively low. The use of air for preaeration of the supernatant was not thought advisable due to the very strong odors produced.

Reservoirs and Swimming Pools

In the afternoon **Dr. H. K. Read,** President of the Texas Public Health Association, Houston, described a modern swimming pool and discussed methods of sanitary operation to protect the public health. A residual chlorine content of from .2 to .5 p.p.m. should be carried in the pool and bacterial tests made. Control of "athlete's foot" by having the bathers walk through heavily chlorinated water was suggested. Application of sodium thiosulfate was also mentioned as a cure for this infection.

Dr. J. C. Anderson, State Health Officer, outlined the policies of the State Board of Health in regards to public water supplies. He mentioned reviewing of plans, education of operators, bacterial and chemical analyses, ratings based on bacterial results, educational work with well drillers, etc. The attitude of the state board with regard to recreational use of waters impounded for use as public water supplies was made quite definite. Regulatory measures to control the recreational use of such bodies of water is strongly advocated and the sanitation of the watershed is not to be slighted.

Taste and Odor Control—Live Issue in Texas

E. L. Filby of Black & Veatch, Consulting Engineers, Kansas City, spoke on the **"Use of Activated Carbon in Water Purification."** Several plants in Texas are now using powdered carbon for removal of tastes and odors with marked success. Mr. Filby remarked that several plants utilizing chemical precipitation and settling without filtration were anxious to use some form of treatment with carbon but were not in a position to do so, unless filters were installed.

L. C. Billings, Chemist in Charge of Water Purification Plants at Dallas, presented a noteworthy paper on **"Taste and Odor Control in Drinking Water Supplies."** He outlined the three methods—Prevention—Chemical Oxidation and Physical Aeration. The last he found helpful but usually not sufficient. The advantages of spray aeration after filtration were mentioned. Carbon, he thought, was clearly the best adsorbtive available. Ammonia-Chlorine has a definite place in water treatment but it did not, in his opinion, rank first as a control measure for tastes and odors. The necessity of keeping the plant clean and free from algae growths was stressed. Experiences at Waco indicated the necessity of thorough cleaning of filter beds even if these units were shut down after cleaning. Organic matter decomposing in filters gave rise to very objectionable tastes. Aeration was not successful in removing the tastes while activated carbon was. **A. K. Brenneke,** City Engineer, Denison, Texas, reported very successful results from the use of activated carbon.

James D. Fowler of the firm of Koch and Fowler, Engineers, Dallas, presented an enlightening paper on **"Water Works Evaluation in Determining Water Rates,"** indicating that the present value must be the major factor in rate making. Original and replacement costs must also be considered and "going" or earning franchise value allowed. An appraisal of the physical plant at reproduction cost must be made and depreciation—both physical and functional—allowed, etc. The "going" value is one chiefly for rate purposes and is a much argued value. It is a factor not usually figured in for municipal plants.

In the absence of **Walter N. White,** Hydraulic Engineer, U. S. Geological Survey, his paper was read covering **"Some of the Results of the Co-operative Federal and State Investigations of the Underground Waters of Texas."** This co-operative work carried on by the Geological Survey and the State Board of Water Engineers has already proven its worth by indicating the limits to which subsurface waters could safely be removed by irrigation companies.

The last day of the meeting opened with a paper by **O. A. DeCelle** of the International Filter Company, Chicago, on **"Determining Factors in the Selection of Industrial Water Purification Equipment."** In it he described conditions encountered in industrial uses such as bottling plant supplies, railroad waters, hotel supplies, etc. He mentioned the danger of using Zeolite softened water in some hotel piping systems where corrosion became a problem. The inability of Zeolite to stand up in handling a lime treated water was also mentioned. Mr. DeCelle also demonstrated a small "Hydrodarco" granular activated carbon unit for removal of excess chlorine and taste from water.

F. H. Puckhaber, District Representative of Wallace and Tiernan Company, presented a summary covering **"Well Water Pollution"**—citing the false sense of security felt in some localities because of the use of supposedly safe well water. **Chester Cohen** of the Texas State Board of Health outlined the **"Criteria for Determining Sanitary Quality of a Drinking Water Supply,"** touching on the physical bacteriological and chemical criteria. He spoke of the B. coli group as too inclusive and deplored the "empirical" standards already set up for waters. He cited the importance of the sanitary survey and the necessity of proper construction of well. His talk was very largely confined to well waters.

Dr. J. W. Bass, City Health Officer of Dallas, stresses the need for sanitation of source of supply and the need for considering isolated—apparently untraceable—typhoid as due to water transmission. He also mentioned considering the mineral balance in water and need for adequate mineral content.

Herman Rosenthal, Director of the Dallas Laboratories, Inc., gave a paper on **"What Constitutes a Satisfactory Boiler Feed Water."** He described the mineral content of waters and the effect of various treatments. Attention was given to causes of foaming and priming in boilers and dissolved gases were considered. Embrittlement was also mentioned. **C. M. Bardwell** of the National Aluminate Corporation, Dallas, discussed this paper and called to the

attention of the group the use of sodium aluminate as a coagulant.

In the afternoon **W. H. Waring** of the Dallas Water Department, presented a paper on the procedure at Dallas covering **"Installation and Repair of Water Mains."** **D. W. Robinson,** Water Works Engineer of Fort Worth, gave a paper on **"Pipe Jointing Compounds and Materials."** Other papers presented were **"Equipment Necessary for the Efficient Operation of a Small Water Works Service and Repair Shop"** by **T. L. Lain** of Cleburne. **F. A. Schramm** of the Texas State Board of Health outlined the progress of the department in their campaign to eliminate cross connections in Texas.

In the evening a delightful banquet was served on the roof of the Baker Hotel and dancing followed. Newly elected officers are **John B. Winder** of Dallas, President; **A. H. Douglas,** Wichita Falls, First Vice President; **V. M. Ehlers,** Secretary.

LIST OF THOSE IN ATTENDANCE, FOURTEENTH ANNUAL WATER WORKS SHORT SCHOOL, MINERAL WELLS, TEXAS, JAN 18 TO 21, 1932

A. M. Brenneke, City Engr. and Water Supt., Denison.
L. C. Billings, Water Supt., Dallas.
W. M. Chaney, Water Supt., Electra.
A. H. Douglass, Water Supt., Wichita Falls.
W. H. Deaton, Water Works Supt., Waco.
Roy Duckett, Water Works Supt., Sweetwater.
E. J. Elliott, Water Works Supt., Galveston.
E. L. Filby, Cons. Engr., Black & Veatch, Kansas City, Mo.
Jas. D. Fowler, Cons. Engr., 801 Central Bank Bldg., Dallas.
L. A. Grimes, Water Supt., Abilene.
C. B. Groves, Water Supt., Matador.
H. J. Hambleton, Water Supt., Haskell.
E. D. Hopkins, 4317 Roseland, Houston.
J. C. Harris, City Hall, Electra.
Robt. W. Harding, Bexar Co. Water Co., South San Antonio.
E. O. Johnston, Water Dept., Jacksonville.
E. O. Kinnison, W. W. Supt.., Moran.
T. L. Lane, Water Supt., Cleburne.
Guy McGee, Water Supt., George West.
Julian Montgomery, Cons., Engr., 545 Harvey Smiler Bldg., Wichita Falls.
W. S. Mahlie, City Chemist, Fort Worth.
Frank M. Murphy, Water Dept., El Paso.
Roy Matthews, Water Supt., Albany.
W. C. Marlow, City Mgr., Eastland.
T. B. Porter, Southwestern Laboratories, Fort Worth.
W. B. Raney, Water Supt., Sulphur Springs.
J. G. Reagan, Water Supt., Cisco.
L. R. Simmons, Water Supt., Grand Saline.
J. T. Tackett, Water Supt., Graham.
F. J. Von Zuben, Cons. Engr., Fort Worth.
Ben E. Winston, Water Supt., Univ. Park, 3800 Univ. Blvd., Dallas.
G. F. Webb, Dallas City W. W., Dallas.
J. B. Winder, Chief Water Supply Engr., Dallas.
Edgar Whedbee, Asst. Chief Water Supply Engr., Dallas.
Mont E. Young, Water Supt., Goose Creek.
P. J. A. Zeller, Research Chemist, A. & M. College, College Station.
E. A. Kingsley, Atlas Min. Prod. Co., Dallas.
H. B. Guest, American Cast Iron Pipe Co., Dallas.
J. R. Van West, American Brass Co., Houston.
Norman Abrams, Badger Meter Co., Waco.
H. H. Davenport, California Meter Co., Ft. Worth.
Russel G. Davis, Chain Belt Co., Houston.
Wayne A. Kivell, The Dorr Co., Inc., Chicago, Ill.
R. G. Whittington, The Dallas Foundry, Dallas.
Lewis I. Birdsall, General Chemical Co., Chicago, Ill.
W. C. Hoffman, General Chemical Co., Fort Worth.
Sidney P. Armsby, Haden Lime Co., Houston.
J. G. Montgomery, Layne-Texas Co., Houston.
J. A. Keown, Mueller Co., Fort Worth.
E. M. Rollins, Jr., Mathieson Alkali Co., Dallas.
David Morey, Jr., Morey & Morey, Dallas.
Ed Morey, Morey & Morey, Dallas.
D. B. Reynolds, National Meter Co., Houston.
Egmont S. Smith, Neptune Meter Co., Dallas.
H. H. Metcalf, Neptune Meter Co., Shreveport, La.
A. M. Avery, Nat'l Cast Iron Pipe Co., Dallas.
Jack Siedentorf, Pittsburgh Equit. Mtr. Co., Albuquerque, N. M.
J. R. McCrea, Pittsburgh Equit. Mtr. Co., Dallas.
H. E. Schlenz, Pacific Flush-Tank Co., Chicago, Ill.
F. W. Berry, Rensselaer Valve Co., Dallas.
M. H. Collins, Rennselaer Valve Co., Louisville, Ky.
J. B. Waskom, A. P. Smith Mfg. Co., Dallas.
A. P. Jones, Texas Chemical Co., Houston.
L. B. Blalock, T. P. & L., Dallas.
Herman Anderson, Vogt Bros. Mfg. Co., Louisville, Ky.
Fred H. Puckhaber, Wallace & Tiernan, Dallas.
Harry Allen, Water Supt., Goldthwaite.
Mrs. A. M. Avery, Dallas.
H. R. Arrant, City Chemist, Abilene.
W. B. Brodie, W. W. Supt., Alvarado.
Mrs. A. M. Brenneke, Denison.
Charlton Brown, Mayor, Mineral Wells.
Geo. D. Barber, C. of C. Mgr., Mineral Wells.
Norriss Brown, Box 1008, Fort Worth.
Dr. O. D. McBeneyer, Health Officers, Anson.
H. B. Beaumont, Water Supt., Hearne.
Oscar Bish, Water Commissioner, Mineral Wells.
Chester Cohen, State Board of Health, Austin.
B. F. Cherry, Water Supt., Weatherford.
Mrs. Larue DeBusk, Mineral Wells.
M. L. Dalton, Cons. Engr., Dallas.
C. M. Everts, Jr., St. Bd. of Health, Box 375, Lufkin.
A. M. Erskine, Dist. Engr., care of Sparks Hotel, Dublin.
G. D. Fairtrace, City Mgr., Fort Worth.
B. L. Grimes, Dist. Engr., Box 881, San Angelo.
D. W. Gray, Water Supt., Anson.
W. T. Gooch, Baylor Univ., Waco.
Mrs. H. B. Guest, Dallas.
Allen Guinn, Mineral Wells.
H. E. Hargis, Dist. Engr., care of City Mgr., Lubbock.
Mrs. E. D. Hopkins, Houston.
Mrs. H. J. Hambleton, Haskell.
W. E. Henderson, Greenville.
Chas. Johnston, Daily Index, Mineral Wells.
Mrs. A. T. Jones, Houston.
W. M. Joiner, Water Supt., San Marcos.
Mrs. J. A. Keown, Fort Worth.
Mrs. E. A. Kingsley, Dallas.
Artie Liles, Eastland.
J. F. Lindsey, City Atty., Anson.
Frank McKeown, Southern City Mag., Stephenville.
T. F. Mitchell, Water Supt., Greenville.
L. M. Morris, Waco.
E. L. Myers, 2204 Tower Pet. Bldg., Dallas.
W. J. Miles, City Engr., Mineral Wells.
J. P. Owens, Fort Worth.
J. W. Porter, 3000 Jonius St., Dallas.
Chester Price, City Health Dept., El Paso.
Mrs. M. Pierson, 501 W. 13th St., Austin.
Mrs. F. H. Puckhaber, Dallas.
Bud A. Randolph, City Health Dept., Houston.
F. A. Schramm, 812 N. Marsalis Ave., Dallas.
F. B. Stephens, Water Dept., Cleburne.
Mrs. Egmont S. Smith, Dallas.
E. V. Spence, City Mgr., Big Spring.
G. Scogin, Water Dept., Abilene.
Eugene Scott, 703 Dallas Bank & Trust, Dallas.
W. L. Simmons, Water Supt., Cisco.
J. R. H. Spence, Water Supt., Breckenridge.
B. M. Turner, Supt. Water Plant, Terrell.
R. K. Tipton, 2801 Chenault, Fort Worth.
F. J. Von Zuben, Jr., Cons. Engr., Fort Worth.
A. B. Vinson, City Hall, Fort Worth.
M. L. Whitney, Allen Bldg., Dallas.
E. M. Wood, Mayor, Anson.
Mrs. Mont E. Young, Goose Creek.
Garrett Phillips, 1418 MacGregor St., Houston.
Dr. Walter Kleburg, City Health Officer, Galveston.
H. L. Thackwell, Cons. Engr., Jacksonville.
Mr. Witt, Milk Inspector, Eastland.
Dr. J. W. Bass, City Health Officer, Dallas.
Clarence DeBusk, Mgr., Chamber of Commerce, Jacksonville.
J. C. Durland, Waterworks Engr., S. P. Lines, Houston.
E. E. McAdams, City Manager, Waco.
Charlton Brown, Mayor, Mineral Wells.
Mr. Chamberlain, Baker Bottling Water Co., Mineral Wells.
J. W. Strange, City Engineer, Waco.
A. B. Eddleman, Mayor, Graham.
Mrs. J. P. Tackett, Graham.
S. S. Payne, Water Supt., Comanche.
L. D. Matter, International Filter Co.
O. A. DeCelle, International Filter Co., Chicago, Ill.
Dr. J. O. Lane, City-County Health Officer, Comanche.
Mr. Lindale, The Dorr Co., Chicago, Ill.
Mrs. Lindale, Chicago, Ill.
Mrs. F. A. Schramm, 812 N. Marsalis Ave., Dallas.
Harry Davidson, Jr., Ft. Worth.
Harvey Miller, County Sanitarian, Mineral Wells.
C. Y. Minchew, County Sanitarian, Dublin.
Mrs. C. Y. Minchew, Dublin.
H. J. Darcey, State Sanitary Engineer (Okla.), Oklahoma City.
R. Henery, Electrified Water Co., Dallas.
Mrs. J. R. Mahone, Austin.
Guy C. Northrup, Hydraulic Dev. Corp., New York City.
Dr. Hedges, Prof. of Chemistry A. & M., College Station.
J. A. Norris, Board of Water Engrs., Austin.
H. Rosenthal, Dallas Laboratories, 2411 S. Harwood, Dallas.
Harvey W. Draper, Texas Municipalities, Kress Bldg., Houston.
Dr. J. H. McCracken, City Health Officer, Mineral Wells.
C. M. Bardwell, 1313 Santa Fe Bldg., Dallas.
Burt B. Hodgman, 50 Church St., New York.
T. W. Halon, U. S. Pipe & Foundry Co., Dallas.
E. W. Steel, Box 273, College Station.
Phil G. Becker, Engr. Dept., City Hall, Ft. Worth.
W. M. Dashiell, Dept. of Public Health and Welfare, Ft. Worth.
Mrs. W. M. Dashiell, Ft. Worth.
E. E. McLulover, City Hall, Waco.
E. P. Seate, Water Works Supt., Ft. Worth.

▼

NEW JERSEY TOWN WILL PROBABLY BE REQUIRED TO REBUILD SEWAGE WORKS.—The State Board of Health of New Jersey is asking the town of Keyport to revamp and add to its antiquated sewage treatment plant. The improvements recommended are reported to cost between $100,000 and $150,000.

▼

NEGLIGENT OFFICIALS FINED IN POLLUTION CASE.—Failure to comply with a court order to discontinue the discharge of improperly treated sewage resulted in a New Jersey borough being fined $500, and in addition the Mayor and Council members were individually fined $100 each. The suit was brought by the State Department of Health.

INDUSTRIAL WATER SUPPLY
AND TRADE WASTES

PURIFYING WATER FOR THE TEXTILE INDUSTRY

By S. B. APPLEBAUM
Vice-President, The Permutit Co., New York City

Part II: A Description of Actual Accomplishments and of Plant Installations

Foreword

PART I of this article dealt with specific improvements in the textile industry effected by water purification, particularly in the manufacture of wool, silk, cotton and rayon products.

A specification of an ideal water for textile purposes was given. The methods of water purification required to produce such ideal water were discussed. Under the topic "Clarification" the recent advances with "aids" to coagulation, such as the effect of agitation, the use of inert matter applied to the water such as clay and finally the effect of controlling the pH values in the treatment were discussed. The design of equipment was presented and a discussion of softening by zeolite was included.

The following installment shows how these improvements in principle were carried out in actual practice.

To illustrate how these aids to coagulation, filters and softeners are applied on a large scale, we have taken three typical cases of large textile mills that have installed complete water purification plants to produce the ideal effluent specified above.

Case No. 1—A large cotton finishing plant.

Case No. 2—A large carpet factory involving the scouring and dyeing, etc., of wool.

Case No. 3—A large rayon plant.

Case No. 1—A Cotton Goods Mill in South Carolina, Bleaching, Dyeing and Printing Cotton Goods

In Table III will be found data descriptive of the clarification plant installed at this mill. In Table IV will be found a chemical analysis of the raw water and a chemical analysis of the final effluent. It will be noted that the raw water came from a small creek and that there was very little dissolved solid content in the water. Nevertheless it contained a very high amount of color, iron, and organic matter, and the bleaching of cotton goods requires a water that is as free from these impurities as possible. The analyses show that the chemical treatment and settling alone removed over 80 per cent of the color and practically all of the iron. The filtration that followed completed the reduction in the organic matter, turbidity, and color to negligible values. The color was reduced from an initial value of 90 down to 10, the organic matter from 40 down to 8 and the iron from 1.4 down to 0.1. A concrete settling basin provides a detention period of 2 hours and includes the aids to coagulation mentioned above, namely, a mechanical paddle agitator and a clay feed. A sodium silicate feed is included to act as an after-treatment in order to prevent the possibility of picking up any iron by corrosion of pipe lines. The silicate forms a coating or film on the interior of the pipe lines which prevents corrosion. Figure 4 shows in diagrammatic form the arrangement of the entire plant from

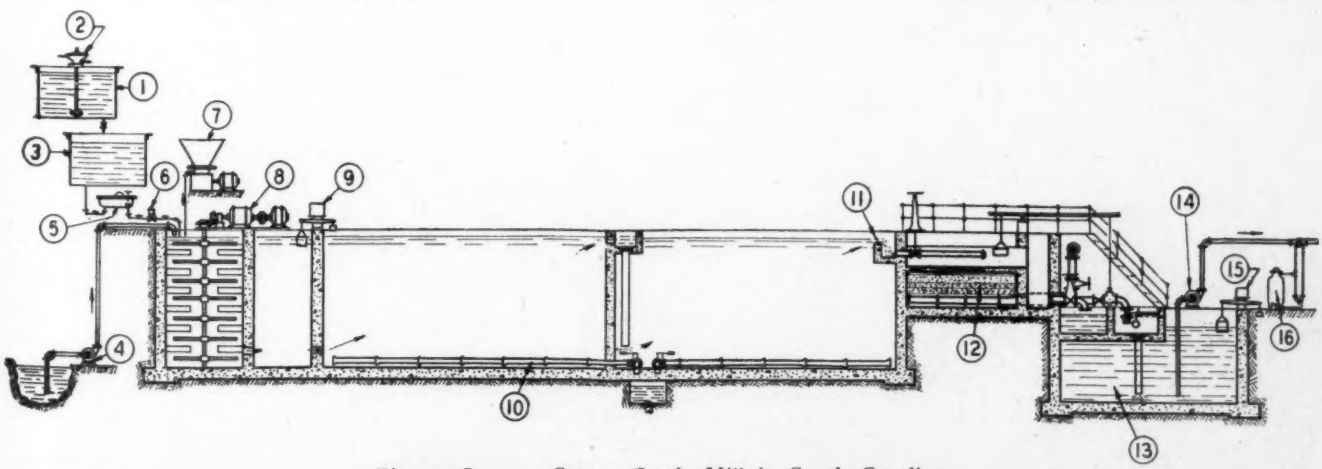


Fig. 4—Case 1: Cotton Goods Mill in South Carolina

(1) 2 Chemical Mixing Tanks, One for Alum, Other for Alkali. (2) Water Motor Agitator in These Mixing Tanks. (3) Chemical Solution Tanks. (4) River Pump. (5) Orifice Box. (6) Motor Operated Valves. (7) Clay Dry Feed. (8) Motor, Gears and Mechanical Agitator. (9) Float Switch. (10) Tile Pipe Sludge Removal System. (11) Weir Outlet. (12) Filters. (13) Clear Well. (14) Service Pump. (15) Float Switch Controlling River Pump and Chemical Feeds. (16) Silicate Feed.

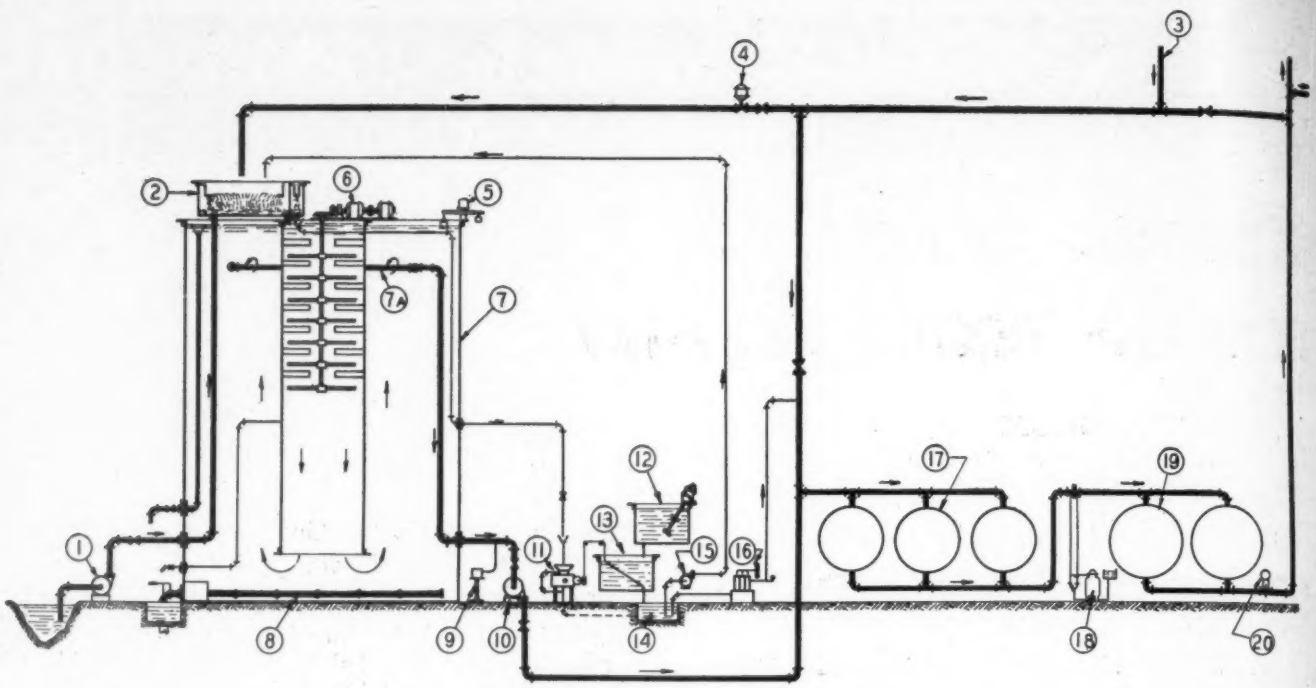


Fig. 5—Case 2: A Large Carpet Factory in the East

(1) River Pumps. (2) Weir Box. (3) City Water Line. (4) Motor Operated Valve on City Water Line. (5) Float Switch to Control River Pumps and Motor Operated Valve (4). (6) Motor, Gears and Mechanical Agitator. (7) Steel Settling Tank. (7A) Drawoff Collector in Settling Tank. (8) Tile Pipe Sludge Removal System. (9) Chlorinator. (10) Service Pumps. (11) Chemical Feed Control. (12) Alum Dissolving Tank with Motor Propeller Agitator. (13) Alum Feed Tank. (14) Alum Dilution and Suction Well. (15) Low Pressure Alum Pump. (16) High Pressure Alum Pump. (17) 14 Horizontal Pressure Filters. (18) Silicate Feed. (19) 9 Horizontal Zeolite Softeners. (20) Flow Meter.

river to clearwell. It is to be noted that the settling basin has a sludge system at the bottom, consisting of tile pipes evenly spaced with orifices at the joints, so that by opening the quick opening gate valves on the outside of the basin, the sludge which lies above these pipes is blown out evenly from all sections of the basin. This avoids the necessity for draining the basin and for removal of sludge by flushing and shoveling, etc.

Case No. 2—A Large Carpet Factory in the East

A description of the filter plant, as well as analyses of the raw and finished waters are given in Tables III and IV, respectively. The plant was installed for a capacity of 6,500 g.p.m., which is over 9,000,000 gallons per 24 hours. Figure 5 is the flow diagram of the installation. Figure 6 shows the settling tank and filter

TABLE III—EQUIPMENT INSTALLED AT TYPICAL PLANTS

	CASE I	CASE II	CASE III
Capacity Gallons per day	2,165,000	9,360,000	1,000,000
Chemical Feeds	Solution Type for Alum and Soda Ash	Solution Type for Alum	Solution type for alum and soda ash
	Dry Feed for Clay	Pressure Solution Feed for Sodium Silicate	Dry Feed for Clay
	Pressure Solution Feed for Sodium Silicate	Solution Feed for Chlorine	Pressure Solution Feed for Sodium Silicate
	Solution Feed for Chlorine		Solution Feed for Chlorine
Sedimentation:			
Type	Concrete Basin	Steel Tank	Steel Tank
Dimensions	50'0"x54'0"x10'0"	46'0"x50'0" high	24'0" dia. x 29'0" high
Capacity	180,000 gallons	600,000 gallons	96,000 gallons
Detention Period	2 hours	1½ hours	2 hours
Accessories	Sludge Removal Systems Mechanical Agitator	Sludge Removal System Mechanical Agitator	Sludge Removal System Mechanical Agitator
Filters:			
Type	Concrete Gravity	Horizontal Steel Pressure	Horizontal Steel Pressure
Number	Five	Fourteen	Four
Dimensions	10'0"x16'0"	8'0" diam. x 25'" long	8'0" dia. x 16'3" long
Nominal Filter Rate g.p.m./sq. ft.	1.9	2.3	1.5
Softeners:			
Type		Horizontal Steel Pressure Zeolite	
Number		Nine	
Dimensions		10'0" diam. x 23'0" long	
Nominal Softening Rate g.p.m./sq. ft.		4.6	

TABLE IV—TYPICAL CHEMICAL RESULTS IN P. P. M.

	CASE I			CASE II			CASE III	
	Raw Creek	Settled	Filtered	Raw River	Filtered	Softened	Raw River	Filtered
Hardness, as $CaCO_3$	3	3	3	134	134	0	220	220
Methyl Orange Alkalinity, as $CaCO_3$	9	19	25	108	88	88	144	30
Phenolphthalein Alkalinity, as $CaCO_3$	0	0	0	0	0	0	0	0
Causticity, as $CaCO_3$	0	0	0	0	0	0	0	0
Free Carbon Dioxide, as CO_2	7	10	8	10	30	30	10	30
Iron (Total), as Fe	1.4	0.1	0.1	2.0	0.2	0.2	3.0	0.1
Organic Matter, as $KMnO_4$	40	15	8	24	12	8	225	20
Turbidity	25	10	0	75	0	0	15	0
Color	90	25	10	80	10	10	30 to 130	3 to 15

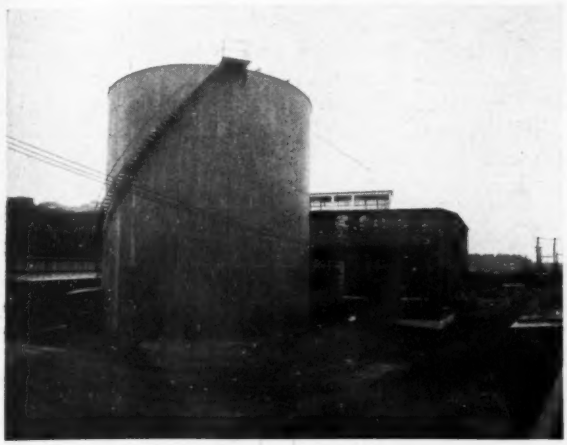


Fig. 6—Settling Tank and Filter Building at a Large Carpet Factory in the East

building. Figure 7 shows the pressure filters on one side and pressure zeolite softeners on the other. Figure 8 shows the chlorinator, low pressure and high pressure alum pumps, alum feeding tanks and feeding device.

This plant had been using very large quantities of city water, in addition to a small stream that ran near their

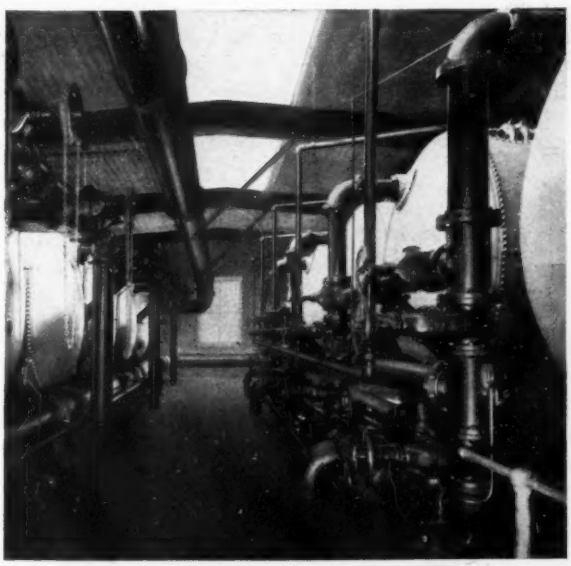


Fig. 7—A Typical Battery of Zeolite Softeners on One Side and Filters on the Other

property. By putting in the complete water purification plant, so that they could use the river water, even when it was turbid and normally unfit, they were able to save many thousands of dollars annually in the cost of the city water alone. From the flow diagram, it is to be noted that the river water is pumped into a weir box, from which it drops into a central downtake where the mechanical agitator acts as an aid to coagulation. Alum sulphate is the coagulant employed and a low pressure alum pump introduces this alum into the incoming water. When the flow of river water is insufficient in amount, city water to make up the deficiency may be employed and this is controlled through the motor-operated valve which is stopped and started by a float switch in the

Fig. 8—Alum Feeding Equipment and Chlorinator in Filter Plant (Fig. 6)

settling tank. If the city water is clear enough it may by-pass the settling tank and go direct to the filters and in that event a small stream of alum sulphate may be fed directly into the filters to produce the slight mat of floc on top of them. The silicate feed is used for protection of pipe lines from corrosion and zeolite

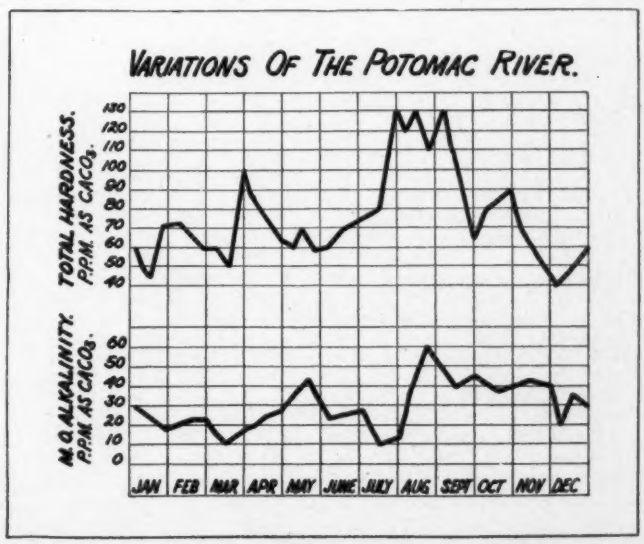


Fig. 9—Changes in Quality of Untreated Potomac River Water —Rayon Mill Supply

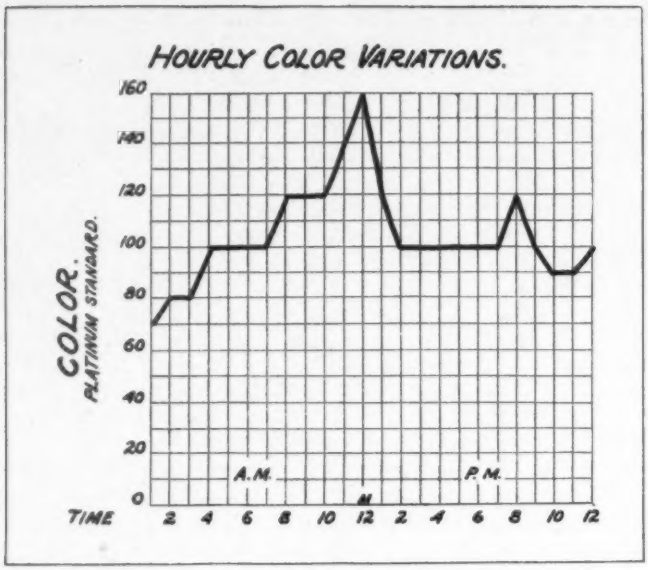


Fig. 10—Hourly Color Variations in Untreated Potomac River Water—Rayon Mill Supply

softeners are employed to remove the hardness completely from the water. In order to save floor space, a double deck arrangement of filters and softeners was employed, so that 7 filters were on the ground floor and 7 filters on the first floor and on the other side of the operating gallery there were 4 softeners on the ground floor and 5 softeners on the first floor.

On the average about 1.1 grains of alum per gallon were found sufficient for good coagulation throughout a year. The results obtained are as shown by the analysis, a perfectly clear water with very low color and organic matter and of zero hardness, which is ideal water for wool scouring and dyeing, finishing and boiler feed.

Case No. 3—A Large Rayon Plant on the Potomac River

The water treatment equipment was installed for a capacity of 1,000,000 gal. per day. Before this complete water purification plant was installed, a battery of pressure filters was used, filtering the river water direct, with the addition of a little alum into the suction of the river pumps, but the effluent was not of a satisfactory enough quality for rayon work. The river is high in color at this point. At times the color reaches a figure of 350, which constitutes a very highly colored brownish water. The turbidity at such times is low and the water is very resistant to coagulation. In the past as much as 14 to 17 grains of alum per gallon of water had been used in an attempt to coagulate this water. Industrial wastes from mills up the river also caused trouble in coagulation by introducing organic matter that causes slow response to coagulation. A water of extremely low color was desired, even when the raw water contained a color of several hundred on the usual A.P.H.A. color scale. Figure 9 shows the variation in composition of the Potomac River throughout a year and shows clearly what great difficulty a textile mill would have in adjusting their formulæ for processing of their rayon in such water. Therefore a water of uniform quality was requested. Figure 10 shows how the color of the raw water varies from hour to hour in one day and indicates the difficulty that this mill had to contend with in proper coagulation of this water.

Extensive experiments were made to determine what aids to coagulation might be required and a description of the equipment and the results obtained are given in Tables III and IV, respectively. Figure 11 gives in diagrammatic form the equipment that is in use. It is to be noted that electro-chemical feeds are employed and that a clay feed and agitator, as aids to coagulation, are included. Furthermore, a chlorinator was installed because it was found that by chlorinating the water, coagulation is improved and filter alum is saved. In addition, the alum feed is made with a lead lining, so that sulphuric acid may be added to the alum in order to reduce the pH value, because it was found that when the color was very high in the raw water, the optimum coagulation took place at a pH value of slightly under 6. A silicate feed is included to protect the pipe lines from corrosion but it has not been found necessary to operate it continuously. In fact, at times, the operation of the feed one day a week is all that is required to introduce a coating on the lines sufficient to prevent any iron from being introduced into the finished water.

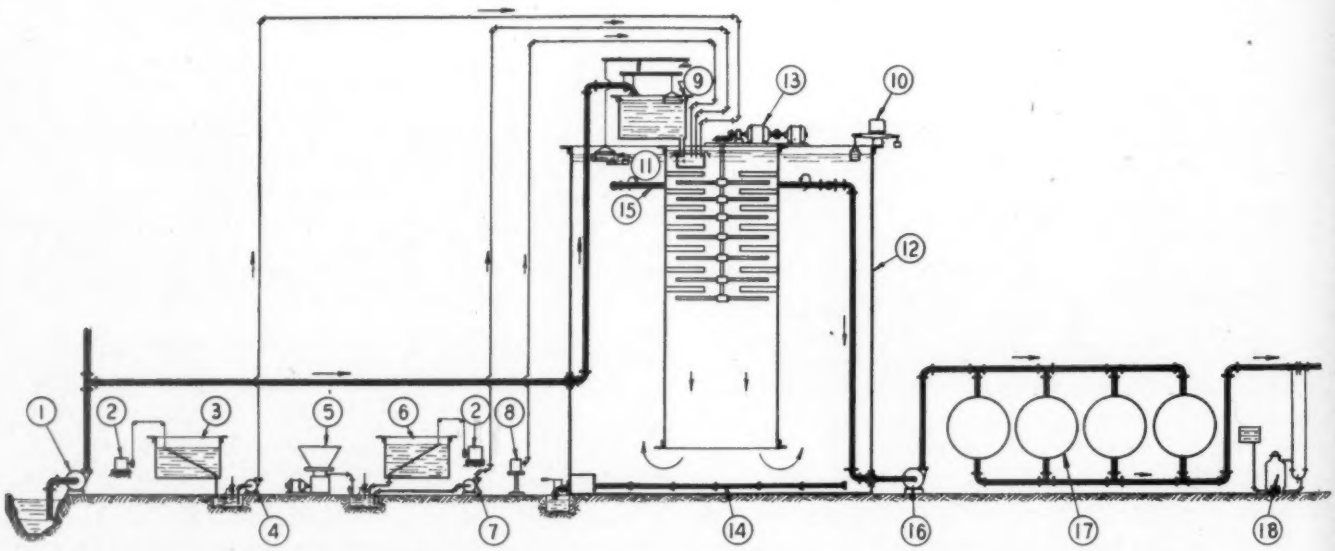


Fig. 11—Case 3: A Large Rayon Plant on the Potomac River

(1) River Pumps. (2) Electro-Chemical Feed Control Units. (3) Alum Feed Tank. (4) Alum Pump. (5) Clay Dry Feeder. (6) Alkali Feed Tank. (7) Alkali Pump. (8) Chlorinator. (9) Head Box Rate of Flow Controller. (10) Float Switch to Control Chemical Feeds. (11) Float Pot to Shut Off Raw Water When Tank Fills. (12) Steel Settling Tank. (13) Motor, Gears and Mechanical Agitator. (14) Tile Pipe Sludge Remover. (15) Drawoff Collector Pipes in Settling Tank. (16) Service Pumps. (17) 4 Horizontal Pressure Filters. (18) Silicate Feed.

UNDERGROUND SEWAGE PLANT SERVES SPRING LAKE, N. J.

Has Solved a Problem Which Confronts Many Seashore Resorts

By P. N. DANIELS and
C. H. CAPEN, JR.
Consulting Engineer, Trenton, N. J.;
Consulting Engineer, West Orange, N. J.

CONFRONTED with an acute problem in beach pollution and anxious to comply fully with the high standards of sanitation set by the State Department of Health, Spring Lake, N. J., one of the most attractive beach resorts on the Jersey coast, has solved its problem in a unique manner which should serve as a powerful incentive to summer resorts of New Jersey and elsewhere that are without adequate sewage treatment. Employing the highly effective separate digestion process followed by chlorination, the Spring Lake plant leaves little to be desired technically. The unique touch, however, that crowned with success the efforts of the borough was the locating of the entire treatment plant in an underground vault with nothing save an attractive pumping building and an ornamental steel flagpole visible from the closely adjoining residential and hotel districts. Thus, have both the utilitarian and aesthetic considerations been met, as is highly proper for a seashore resort which relies for its success on clean beaches and attractive residential areas along the ocean front.

Spring Lake is directly on the Atlantic Ocean, 60 miles south of New York City and four miles south of Asbury Park. It is the fortunate possessor of two miles of broad, sandy beach which affords safe surf bathing along its entire length. The all-year-'round population amounts to about 1,800, but during the summer months this is augmented to 12,000 to 15,000 by the summer residents who return each year to the cottage community or large summer hotels along the ocean front.

This ocean front property has steadily increased in value during the last 25 years and is served by Ocean Avenue, a 100-ft. wide boulevard, paralleling the ocean and separated from it by a broad and attractive expanse of closely cropped lawn, with here and there a flower bed or a walkway flanked with hedges. To the east of this expanse of lawn lies the boardwalk, bathing pavilions and finally, the beach, while on the other side there extends mile upon mile of large summer hotels, private residences and bathing and tennis clubs. The effect produced is highly attractive and upon this the community largely depends for its popularity.

Each street running inland from Ocean Ave. is sewered by mains averaging 8 in. to 10 in. in diameter. Formerly these terminated in septic tanks close to the boardwalk, the effluent from which gravitated to short outfall sewers leading into the ocean. Obviously, this crude method of treatment left much to be desired, for disagreeable odors frequently were noticeable and unsightly conditions along the beaches and in the surf created much unfavorable comment from the summer residents.

Plant Location and Arrangement

After having decided to proceed with the construction of a modern treatment plant, the authorities were confronted with a formidable problem. On the one hand public opinion favored the location of the treatment works as far from the residential community as possible, while on the other hand the topography of the land and the existing system made a beach front site the most economical location and the best from an engineering standpoint. The residential community was out of the question as a site for a conventional type of treatment plant for obvious reasons, and the selection of an inland site would mean extensive changes in the existing sewer system and expensive two-way pumping, first to the treatment plant and second, from the treatment plant to an outfall sewer in the ocean. The successful reconciliation of the several divergent considerations by using the ocean front site, best suited to the engineering requirements, and concealing the entire treatment plant under several feet of ground is something of a unique achievement in modern sanitary engineering practice.

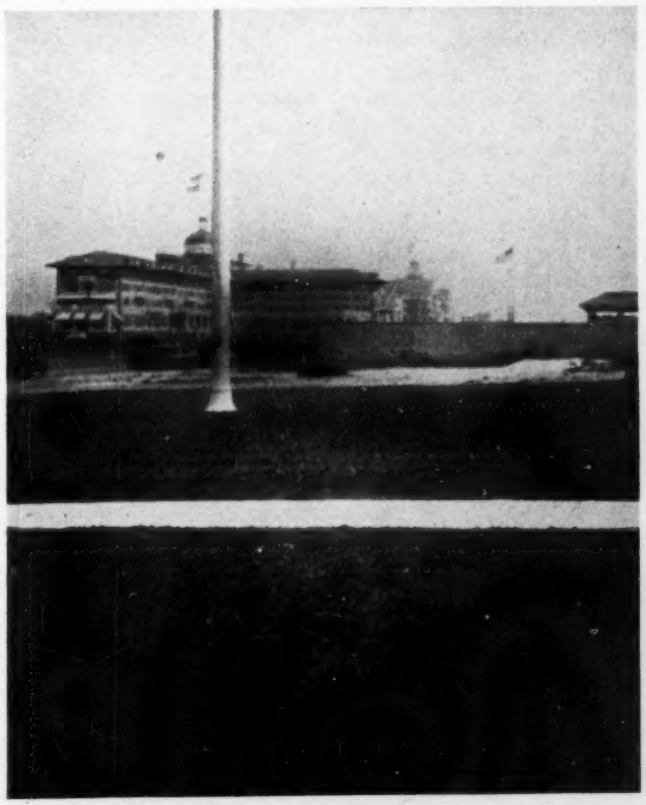


Fig. 1—A Sewage Plant Beneath a Flagpole on an Attractive Lawn. Note Nearby Resort Hotels

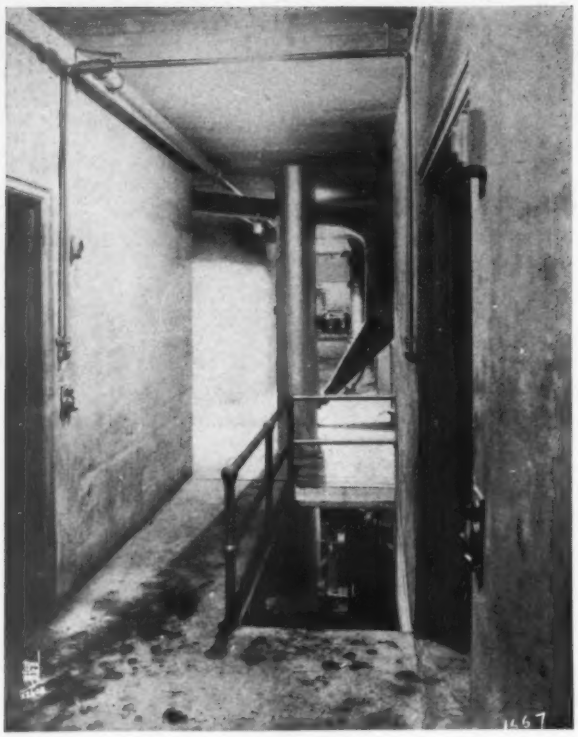


Fig. 2—First and Second Underground Levels of Spring Lake, N. J., Sewage Plant. Base of Flagpole Used for Ventilating Purposes, Showing Ventilating Ducts and Fan Box

The existing south and central septic tanks were intercepted by a 15-in. interceptor, extending 5,400 ft. along Ocean Ave. and terminating at the plant site. This site is within a few hundred yards of the three largest hotels and the south bathing pavilion; it lies directly between Ocean Ave. and the bathing beach. The normal level of the sewage in the plant is 2 ft. below mean low water, so it was necessary to install low lift pumps to discharge the sewage through the outfall sewer.

The treatment plant occupies three levels or floors. At the street level are the pump motors, switchboards, recording meters, chlorinators, a standby gasolene driven generator, laboratory and office. All of this is arranged very compactly and housed in a small and attractive building which harmonizes architectually with the adjacent municipal casino and bathing pavilion. A stairway leads to the floor below on which are located a Dorrco mechanically cleaned bar screen 3 ft. x 3 ft., equipped with float control, three Dorr traction clarifiers, 30 ft. square by 10 ft. deep and a Dorr digester of the gas collection and heated type 35 ft. x 12 ft. A stairway from this level leads to the third or lowest floor which contains the low lift sewage pumps, the Dorrco diaphragm sludge pumps serving the clarifiers and the gas heated boiler, hot water circulating pump and other auxiliaries used with the digester.

The clarifier effluent is chlorinated with Wallace & Tiernan apparatus and pumped to sea by Fairbanks-Morse pumps, through a 16-in. outfall sewer 1,200 ft. long. It may be of interest to note that this sewer passes into the ocean at a point only a hundred yards or so from the most popular bathing beach. There is not the slightest evidence of pollution and it is extremely doubtful whether more than a dozen or so of the many bathers using this beach have the slightest idea that a sewage treatment plant is in the immediate vicinity.

Screenings are collected in metal containers and raised to the ground level by a manually-operated elevator and trucked to the municipal garbage incinerator daily. In order to permit trucking above and to provide for any future excessive loading of the area fronting on Ocean Ave., the roof of the vault was designed to support a 5-ton truck plus 3 ft. of filler.

Sludge Disposal by Pumping to Sea

The raw sludge settled in the clarifiers is pumped several times during the day into the digester. The capacity of this digester and an adjoining sludge storage tank (formerly a septic tank) is great enough to make it unnecessary to withdraw digested sludge except during the winter months. Well before the summer season arrives the digested sludge is pumped to sea through the outfall sewer, thus making it unnecessary to draw sludge again until late in the fall after the summer residents have departed.

The gas collection and utilization system is of the conventional type, but possesses certain interesting features in connection with the venting of the products of combustion and alternative uses for the gas. The stack of the gas heated boiler is connected by a pipe to the base of a hollow, ornamental flagpole, constructed of copper-bearing steel which vents the products of combustion to the atmosphere at a point 100 ft. above the ground level. A gilded weather vane at the top and an American flag fluttering in the breeze belie the utilitarian function performed by the flagpole. During the entire year the sludge gas is used for keeping the contents of the digester at the optimum temperature. In the summer time, however, when a great excess of gas is produced it is planned to pipe the gas to the laundry adjoining the municipal bathing pavilion, to be used there for heating water.

Preventing Odor Nuisance

The hollow flagpole is also used in connection with the forced draft ventilating system. Ventilating ducts

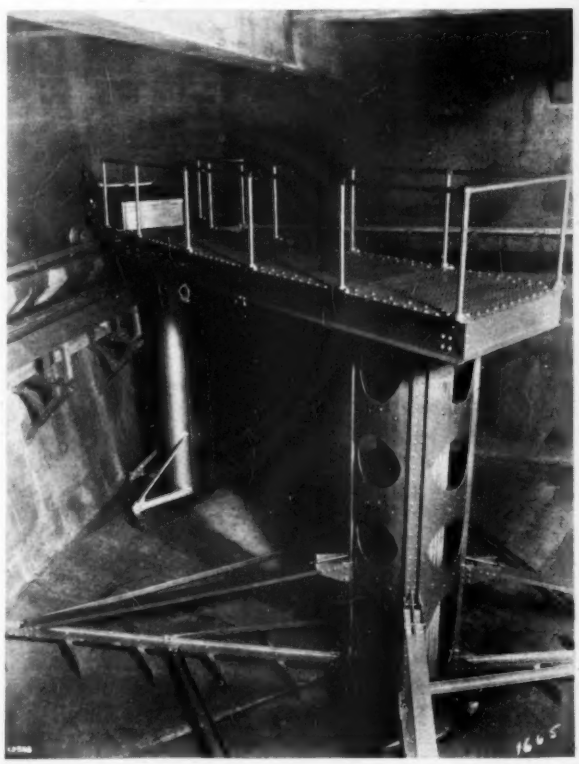


Fig. 3—Spring Lake, N. J., Sewage Plant; Three Dorr Traction Clarifiers and One Digester Are Located on First Basement Level

lead from the clarifier and digester compartments as well as from the passageways and corridors to a forced draft fan which exhausts them into the flagpole and thence to the atmosphere high above the street level. Fresh air passes into the underground vault through the stair well and through several hydrant-shaped air inlets which are provided with balanced dampers at their lower ends to prevent escape of air directly from the vault but permitting it to be drawn inward from the outside.

The capacity of this plant is 1,200,000 gallons per day and the cost was about $200,000 including intercepting services. All motors and switches installed below ground are of the explosion-proof type.

The writers were retained as consulting engineers for the preparation of the design and specifications. The supervision of construction was by G. Roland Moore, Borough Engineer, and his resident engineer, John Van Nuys, with the Thomas Procter Sons Company as general contractors.

Spring Lake's mechanically-operated, separate digestion plant, the only one of its type in existence located completely below ground, shows what can be done by camouflaging sewage treatment plants in residential communities and particularly at beach resorts where the topography so frequently places the ideal site in the highly restricted and valuable shore front district. The small part of this plant that lies above ground and the surrounding lawns are attractive in appearance, and there have been no complaints, from owners of adjoining property based upon depreciation of their holdings through proximity to the plant or upon injury to health or comfort from odors.

▼

Rutgers Short School for Sewage Plant Operators

Rutgers University held three short courses for sewage plant operators Feb. 29, to March 12, 1932, under the direction of the College of Engineering in cooperation with the New Jersey Sewage Works Association and the New Jersey State Board of Health. The 1932 school was the sixth one held.

These courses were planned to provide instruction in the fundamentals essential to successful plant operation and management: to give a general knowledge of sewage disposal and its relation to the public health; and to afford an opportunity to those men wishing to become operators, to qualify themselves to meet the requirements of the New Jersey State Department of Health.

The customary certificates of attendance were given those who desired them. These certificates are issued only to those who have attended not less than 85 per cent of the regularly scheduled sessions of the course, including special lectures and inspection trips.

All courses were under the direction of H. N. Lendall, Professor of Municipal and Sanitary Engineering. The laboratory work of Course I was given by Dr. P. A. van der Meulen and Dr. Willem Rudolfs, assisted by his staff, had charge of the laboratory work and accompanying lectures of Courses II and III.

COURSE I: Elementary hydraulics; sewerage systems; characteristics of sewage, methods of sewage disposal; types of treatment plants; operation. In the laboratory those principals of chemistry applicable to sewage disposal were covered.

COURSE II: Methods of sewage treatment; types of plants; design and construction; operation; records and reports. The laboratory work covered tests and analyses of sewage; interpretation of results; plant troubles; elementary bacteriology.

COURSE III: (a) Sewage plant testing; sampling; analyses; interpretation of results; reports. The work involved the study of a plant in actual operation.

(b) Plant operation. Advanced study in plant operation and design. The course was open to engineers and operators who had had sufficient training to carry on the work.

Definite periods were assigned for informal discussion of the various problems of plant operation. These discussions were led by men of experience and authority in the field of sewage disposal.

Inspection Was Made of the Following Plants.—Thursday, March 3—Red Bank, Spring Lake, Lakewood, and Freehold. Thursday, March 10—Madison-Chatham, Morristown, and Boonton.

Informal lectures with discussion were held on Friday of each week, as follows:

Friday, March 4—"Operation of Separate Sludge Digestion Plants." Ensley M. White, Operator of the Red Bank Plant; Edward P. Hyland, Superintendent of Water & Sewers, Moorestown, N. J.; W. C. Mallalieu, Sanitary Engineer, Jersey City Water Works, Boonton; Leroy Forman, Senior Chemist, and Stephen A. Kowalchik, Assistant Sanitary Engineer, New Jersey Department of Health.

Friday, March 11—"Operation of Activated Sludge Plants." Paul Molitor, Superintendent of the Madison-Chatham, N. J. plant; C. W. Dare, Superintendent of the Collingwood, N. J., plant; Floyd Hoffman, Superintendent of the Morristown, N. J. plant; Weston Gavett, Engineer with Clyde Potts of New York City.

▼

New Jersey State Health Department Staff Enlarged

New employees added to the staff of the State Department of Health of New Jersey in October included two district health officers, three assistant sanitary engineers, two water-shed inspectors, one laboratory assistant and two clerk-typists.

D. C. Bowen, formerly Director of Health, and Clyde R. Newell of Freehold have been appointed district health officers. Mr. Bowen is known throughout the state and has been engaged in public health work since 1891.

Mr. Newell taught at Yale and at the University of Illinois, was engineer under the Illinois State Water Survey, health officer under the North Dakota State Board of Health, dealt with water purification while serving overseas as captain in the Sanitary Corps, and has engaged in mosquito control activities in Florida.

The new sanitary engineers are: Leigh W. Morrill of Collingswood, a graduate in civil engineering from Drexel in 1924, who for five years has been associated with a large engineering firm constructing sewage and water treatment plants; Donald M. Ditmers of Trenton, Princeton '30, who received his C.E. degree at that university last June. Robert S. Shaw of Lawrence Township, also a Princeton graduate in 1930 and resident engineer in charge of construction at the Long Branch sewage disposal plant.

The two water shed inspectors are: John H. Crabiel of Pennington, a graduate of Dickinson in 1930, and Lewis W. Klockner, Jr., of Bloomsbury, Lafayette '30.

PROGRESS IN SEWAGE PRACTICE: A REVIEW OF CURRENT LITERATURE

By C. E. KEEFER
Baltimore, Md.

New Sewage Treatment Projects

AMONG the more important sewage projects, which are being studied, one of the largest is that of treating the sewage from **Minneapolis and St. Paul**[1]; where it is planned to construct about 40 miles of outfall and intercepting sewers at a cost of $10,340,000 and a sewage works costing about $3,840,000.

New York City is now constructing[2] what will be the largest activated sludge plant in the world. The works will serve an area of 7,420 acres, and will treat 180 M.G.D. of sewage from a population of 1,350,000. There are 8 preliminary settling tanks, with a detention period of about one hour, equipped with revolving mechanisms for sludge removal and grease skimming. The aeration tanks, 16 in number, are of the spiral flow type with curved baffles and are designed to give an aerating period of 5¼ hrs. at an average flow of 180 M.G.D. plus 25 per cent of return sludge. There are 32 final settling tanks, each with a surface area of approximately 7,500 sq. ft. and an effective depth of 12 ft. to give an average flow through rate of 1,000 gal. per sq. ft. surface area per day.

Mixed crude and activated sludge will be concentrated in four steel tanks of the suspension coal-bunker type, each with a net capacity of 45,000 cu. ft. Clear liquid separating will be decanted off to enter incoming crude sewage. The sludge will flow by gravity from these tanks to boats, which will carry the material to sea.

Recent additions to the sewage works at **Essen-Rellinghausen,**[3] Germany, consisting of grit chambers, a grease removal tank, a preliminary settling tank, equipped with Dorr sludge removal equipment, two sludge digestion tanks and other miscellaneous improvements. The grease separation is accomplished by diffused air and the tank has a detention period of 5 minutes. Air consumption amounts to 0.013 cu. ft. per gal. of sewage, and 2.12 cu. ft. of grease is skimmed off daily.

A unique feature of the Dorr settling tank, (detention period of 2 hours), is the chamber below the center of the tank in which the sludge collects and is there further concentrated before it is removed. It is stated that the original volume of the sludge is reduced 50 per cent. There are two separate sludge digestion tanks, each about 51 ft. in diameter with a capacity of 49,400 cu. ft. each, equipped for heating by means of pipe coils or by adding hot water direct to the sludge. Both are covered so that the gas can be collected and sludge can be circulated by pumps. Two-stage digestion is practiced, the sludge remaining 18 days in the first tank and 26 days in the second. Only the first tank is heated and 2,900 gal. of hot water added daily keeps the temperature at 73 deg. F. The total volume of fresh and activated sludge (97 per cent water) digested daily amounts to 6,350 cu. ft. Daily gas production amounts to 31,770 cu. ft., or 0.56 cu. ft. per capita. About 5,650 cu. ft. of gas is required for heating; the remainder is delivered to the municipal gas works. The total cost of the sewage works was $275,000, or $5.00 per capita. The annual operating costs are $15,000 or $.275 per capita.

Dagenham's Sewage Works,[4] situated at Rainham, Essex, England, and designed to treat a sewage flow of 1.2 M.G.D. are to be extended at a cost of about $900,000 to treat an immediate flow of 8.4 M.G.D. and a future flow of 10.2 M.G.D. The screened sewage is received in a circular sedimentation tank of the Prüss improved type, providing 3 hour detentions for 3.6 M.G.D. The settled sewage will be aerated by means of Simplex aerators with 4 hour detention. Provision is made for the re-aeration of the activated sludge in diffused ridge and furrow tanks, which provide 14 hours' detention and a 25 per cent concentration of sludge. The activated sludge settles in cone-bottom tanks, which provide 3 hours' detention. Sludge is to be digested in a Dorr digestor having a capacity of 1.33 cu. ft. per capita.

The new sewage works nearing completion at **Dearborn, Michigan,**[5] at a cost of approximately $455,000 will be the first plant of its kind. It will rely entirely upon mechanical and chemical processes, and will be required to treat a maximum flow of 6 M.G.D.

Lime, ferric chloride and paper pulp are to be added to the sewage, which will then pass through a baffled mixing chamber and into a 60-ft. Dorr clarifier. In leaving the clarifier the sewage will flow upward through magnetic filters, 8 ft. wide around the inside of the tank, and is then to be chlorinated. The sludge is to be pumped to Oliver vacuum filters.

A new activated sludge plant for **Pawtucket, R. I.,**[7] is to be completed by Oct. 1, 1932. The plant, designed to serve 100,000 persons, will consist of 2 detritors, duplicate bar screens, 3 sedimentation tanks with mechanical sludge removal apparatus, 2 heated digestion tanks, and 18 sludge beds.

The treatment plant at **Farmington, N. Mex.,**[10] a town of 2,200 persons, was built at a cost of $10,000, and has several features unusual in small community plants. It consists of an Imhoff tank, sprinkling filters and sludge drying beds. There is a scum trough on each side of the Imhoff tank gas vents so that scum can be drawn off from time to time. A crank located on the side of the tank and connected to a paddle shaft running the full length of the tank is used to keep the scum broken up.

The sewage works at **Freeport, L. I.,**[12] designed to serve approximately 10,000 persons, based upon an average estimated flow of 250 gal. per capita, consists of settling tanks, chlorinating chamber, sludge digestion tanks and two glass covered sludge drying beds. The settling tanks have a detention period of 4 hours.

The sludge digestion tanks, placed partly above ground, provides for 10,000 persons upon the basis of 4.5 cu. yds. of sludge per million gal. of sewage

and a detention period of 150 days. The sludge is removed, by gravity, to the drying beds about every 3 months. The glass covered drying beds have a total area of approximately 5,000 sq. ft. The total cost of the sewerage system, including the treatment plant, pumping station and sewers was $1,035,931.

A novel sewage disposal plant completed at **Spring Lake, N. J.,** is designed to provide for a population of 25,000 at a cost of $200,000. The entire plant with the exception of a small building is below ground. (For description of plant see this issue of WATER WORKS AND SEWERAGE.)

A sewage plant[4] designed for 150,000 gal. per day was recently completed at **Sweet Briar College, Va.,** at a cost of $15,000. The plant consists of bar screens, grit chamber, an Imhoff tank, dosing tank, filter bed, final sedimentation tank, and sludge drying bed. Prechlorination is employed. Precautions have been taken to further eliminate nuisances by covering the screen chamber, the sedimentation chambers and the dosing tank.

Activated Sludge Treatment

The pre-aeration plant at **Decatur,**[35] consists of 6 aeration tanks, of the spiral flow type, which have a total displacement period of 2½ hours with a sewage flow of 10 M.G.D. plus a sludge return of 1.0 M.G.D. Two Dorr clarifiers for settling the aerated sewage, have a total displacement period of 2.6 hours and a settling ratio of 833 gal. per day per sq. ft. These works reduce the influent B.O.D. from 30 to 40 per cent, permitting the settled aerated effluent to be applied to the sprinkling filters at three times the rate that could be used with the un-aerated sewage. This reduction takes place either in the presence or absence of returned sludge.

The bulking of activated sludge at **Milwaukee**[30] has been checked to some extent by using more air. The additional air probably tends to promote biological activity, accelerate flocculation and precipitation. During cold weather the presence of abnormally large quantities of silt and other inorganic materials in the sewage effectively accelerates sedimentation and assists in prevention of bulking.

Trickling Filters

An analysis and correlation of data on **Trickling Filter Loadings**[9] from 15 plants, as reported by Childs and Schroepfer, seem to indicate that the per cent reduction in oxygen demand by any particular trickling filter is not, within reasonable limits, materially influenced by quite wide variations in strengths of sewage or ratio of application. It also appears that the oxygen demand of the filter effluent is directly proportional to the strength of the applied sewage.

In connection with the **Design and Loading of Trickling Filters**[3] it is suggested by Hatch that the filter load be expressed in pounds of oxygen requirement per unit volume of filtering material. The Ohio Department of Health has tentatively set a figure of 250 lb. of oxygen requirement of the applied sewage per acre-ft. as the probable uppermost limit of trickling filter loading for the continuous production of a stable effluent. This corresponds to a load of 5.83 lb. of oxygen requirement per 1,000 cu. ft. of filtering material.

Tests conducted to determine the comparative value of crushed stone and **Gravel as a Trickling Filter Media**[11] show that, so far as the character of the effluent is concerned, the gravel is about as efficient as crushed stone. The unloading characteristics are also the same.

Sludge Treatment and Disposal

Experiences at **Salinas, Calif.,**[31] show that the **Digestion of Activated Sludge with Sludge from Preliminary Settling Tanks** results in the formation of a thin watery scum but that this scum causes no trouble. The supernatant liquor from the digestor will have a higher solid content when activated sludge is being digested than when only crude sewage solids are handled, and that high seeding ratios result in a high solid content of the supernatant liquor.

Due to the extremely high grease and fat content (340 p.p.m.), the average daily gas production was high, ranging from 0.5 to 0.8 cu. ft. per capita when no activated sludge was being digested and from 0.8 to 1.3 cu. ft. when daily charges of activated sludge were introduced into the digestor. The addition of activated sludge, judging from a small number of gas analyses, largely prevented the production of hydrogen sulphide, decreased methane production and increased carbon dioxide production. It was also found that the density of the sludge pumped from the preliminary settling tanks increased as the quantity of returned activated sludge to the influent end of the tanks decreased.

One of the interesting features of the sewage works at **Essen-Frohnhauser,**[24] Germany, is the sludge digestion tank, equipped with two Prüss vertical pumps, which are operated 2 hours daily. In spite of the daily mixing of sludge with the supernatant liquor in the tank, the sludge settles rapidly to the bottom of the tank after pumping operations have ceased, leaving the supernatant at the top. The average production of gas, however, amounts to 0.56 cu. ft. per capita per day. The gas flows to a gasometer with a capacity of 1,765 cu. ft., and is used to operate a 50 h.p. gas engine, which furnishes power for operating compressors and pumps at the sewage works.

Houston, Texas, has recently placed in operation a $200,000 plant for the **Manufacture of Fertilizer from Sewage Sludge.**[14] The sludge is dewatered by vacuum filters and then heat dried. The sludge will be conditioned by use of ferrous sulphate oxidized by chlorine (chlorinated-copperas) is delivered in the desired proportions by means of a variable speed conditioner. Mixing is secured in a baffled tank. The pH of the conditioned sludge is electrically measured before it flows to the filters.

Four large Oliver United disc filters provide a total of 3,200 sq. ft. of canvas filter area; each square foot of the filter disc produces about ½ to 1.0 pound of dry solids per hour. Two oil fired driers are of the direct-indirect heat type; one is 5-ft. in diameter by 60 ft. long, and the other is a 6-ft. dryer, 60 ft. long will produce 15 tons of sludge a day.

Sludge Disposal and Gas Utilization

Investigations at the University of Illinois[17] indicate that frozen sludge after thawing will dry very quickly and have a much lower final moisture content than is obtained by drying without freezing. The dried sludge has a spongy appearance, little cohesion, is easily pulverized, has no odor, and separates easily from the sand on the bed.

The Utilization of Sludge Gas at Iserlohn, Germany,[1] effects a saving of $1,250 a year. This gas, which amounts to an average of 0.33 cu. ft. per capi-

ta per day, is used to operate Deutz motors, which furnish power for the plant, generating 20 h.p. from about 6,000 cu. ft. of gas a day, or one horsepower per thousand persons.

Utilization of Gas collected from the digestion of activated sludge at **Rockville Centre, N. Y.,**[19] effects a saving of about $14.00 per day based on the actual reduction of power bills. About 1.0 cu. ft. of gas per capita is now being produced. The gas is being used to operate gas engines and to heat digestion tanks. Records indicate that 20 to 30 cu. ft. of gas per hour per horsepower of work done is required by the gas engines.

Miscellaneous

Providence, R. I., was recently faced with the possibility of replacing about 16,000 manhole frames to eliminate noisy manhole covers.[21] A small-hand-operated machine for grinding the manhole seats solved the difficulty at a considerable saving in money.

A comprehensive discussion covering **Noisy Manhole Covers**[21] discloses a wide variance of opinion as to methods of overcoming this difficulty. It is the concensus of opinion, however, that covers must be fairly heavy if they are to give good service. The most common method used to silence noisy covers is to apply an asphaltic compound around the rim. Special locking devices are installed in some cities. With regard to machining the covers in place, opinions vary as to the advisability of this procedure.

Flow Tests on a 60-in. Reinforced Concrete Sewer,[22] constructed in Essex County, N. J., in 1929, showed an average value of 0.014 for "n" in Kutter's formula when the depth of flow was about one-third of the diameter. Velocities in the test length of 2,209 ft. were about 4 ft. per sec. The surface slope of the flowing water averaged 0.00172, slightly less than the slope of the invert, which was 0.00177.

REFERENCES

Public Works

[1]"Power From Sewage Gas," December, 1931, p. 57.

[2]"Pawtucket (R. I.) to Have Activated Sludge Plant," December, 1931, p. 57.

Water Works and Sewerage

[3]Hatch, B. F., "Trickling Filter Loadings," November, 1931, p. 327.

[4]Johnson, W. Martin, "An Up-to-Date Sewage Disposal Plant at Sweet Briar College, Va.," November, 1931, p. 317.

[5]Owen, Mark B., "Novel Sewage Treatment Process Developed for Dearborn, Mich.," October, 1931, p. 279.

The Surveyor

[6]Frances, T. P., "Dagenham Sewage Extension Scheme; Increased Provisions for Industrial and Domestic Requirements: Some Novel Features," November 20, 1931, p. 503.

Civil Engineering

[7]Childs, J. A., "Sewage Disposal Problems of the Twin Cities," December, 1931, p. 1334.

[8]Fuller, G. W., "Wards Island Sewage Treatment Plant Begun," November, 1931, p. 1260.

[9]Childs and Schroepfer, "Trickling Filter Loadings," December, 1931, p. 1391.

[10]Olmsted, H. G., "Odor Control in Smalltown Disposal Plant," November, 1931, p. 69.

[11]"Gravel as a Trickling Filter Medium," December, 1931, p. 11.

[12]Luther, L. L., "Sewerage and Sewage Disposal at Freeport, N. Y.," December, 1931, p. 72.

[13]Saunders, C. L., "Eliminating Noisy Manhole Covers," January, 1932, p. 78.

The American City.

[14]Tunnell, C. N., "24 Hours from Sewage to Fertilizer," January, 1932, p. 70.

Sewage Works Journal

[15]Hatfield, William D., "Operation of the Pre-Aeration Plant at Decatur, Illinois," October, 1931, p. 621.

[16]Bach, Herman, "The Cardinal Points in the Art of Sludge Digestion—A Compressed Summary of a Quarter Century of Experience," October, 1931, p. 561.

[17]Babbitt, H. E., "Sewage Investigations at the University of Illinois," October, 1931, p. 580.

[18]Haseltine, T. R., "Digestion of Activated and Primary Sludge at Salinas, California," October, 1931, p. 599.

[19]Gavett, W., "Gas Collection from the Digestion of Activated Sludge at Rockville Centre, New York," October, 1931, p. 615.

Municipal Sanitation

[20]Townsend, D. W., "Settling Characteristics of Activated Sludge," January, 1932, p. 18.

[21]"The Round Table," January, 1932, p. 32.

Engineering News-Record

[22]Killam, E. T., "Tests on Large Concrete Pipe Sewer Show Kutter's n to Be 0.014," December 10, 1931, p. 935.

Gesundheits-Ingenieur

[23]Fries, F., "Die Kläranlage Essen-Rellinghausen und die Auswirkung ihrer letzten Erweiterung," Gesundheits-Ingenieur, Vol. 54, p. 661, 681.

[24]Husmann, W., "Betriebsergebnisse und Betriebserfahrungen mit getrennter Schlammfaulung auf der Kläranlage Essen-Frohnhausen," Vol. 54, p. 736.

Oldest of American Sewage Works Associations to Meet at Trenton, N. J.

The New Jersey Sewage Works Association—now 17 years old—will hold its annual meeting at the Hotel Hildebrecht in Trenton, N. J., March 17th and 18th, with Floyd H. Hoffman, of Morristown, N. J., presiding.

P. N. Daniels, one of the founders, is in charge of arrangements and entertainment, wherein he features the now famous "Speechless Dinner"—no speeches but lots of "chatter." Then there's the Methylene Blue quartet and a big time generally.

Aside from the latter, the technical program is always worth the price of admission and here's the one for 1932 as arranged by John R. Downes, Secretary, with the aid of his program committee. The program follows:

THURSDAY, MARCH 17

10:00 A. M Sludge Operations at Baltimore, Md.
Edward C. Cromwell, Principal Sanitary Chemist, Baltimore Sewage Works.

10:45 A. M. Operating Experiences at the Red Bank Plant.
Ensley M. White, Municipal Engineer, Red Bank, N. J.
Discussion by S. A. Kowalchik and Leroy Forman, Engineer and Chemist respectively, State Department of Health.

12:00 Noon. Operating Hazards and Safety Measures.
H. E. Newell, Engineer, National Board of Underwriters.

12:45 P. M. LUNCH.

2:00 P. M. The Activated Sludge Plant at London, Ont.
M. N. Veitch, Engineer of Sewage Disposal, London, Ont.

2:30 P. M. The Activated Sludge Plant at Madison-Chatham, N. J.
Paul Molitor, Superintendent of Sewage Disposal.
Discussion of above papers by Messrs. Donaldson, Gavett, Bowe, Vosbury.

3:30 P. M. Use of Chlorine in Sewage Disposal.
Linn Enslow, Sanitary Engineer, Chlorine Institute and Editor Water Works and Sewerage.

4:15 P. M. Sludge Digestion.
John R. Downes, Supervising Engineer, Plainfield Joint Sewage Works.

5:00 P. M. Experiment Station Report.
Dr. Wm. Rudolfs, Chief of Sewage Investigations.

7:00 P. M. Speechless Dinner and Entertainment.

Evening. Round table discussions.

FRIDAY, MARCH 18

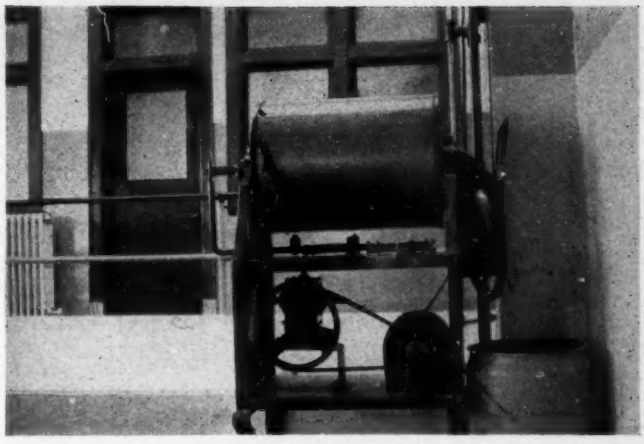
9:30 A. M. Business Meeting.

10:15 A. M. Cleaning Up the Raritan.
Senator Russell E. Watson.

11:00 A. M. The Hackensack Valley Sewerage Commission.
Thomas J. Wasser, Chairman of the Commission.

11:45 A. M. Operations of the License Law.
J. B. Baty, Engineer, State Department of Health.
Discussion by H. P. Croft, Chief, Bureau of Engineering, State Health Department.

1:00 P. M. Further Round Table Discussion.



Omega Rotary Dry Feeder Applying Sodium Bisulphite at Filter Plant, Glencoe, Ill.

SUPER- AND DECHLORINATION AT GLENCOE, ILL.

By E. L. PFLANZ
Superintendent of Glencoe Water Works

THE Village of Glencoe, with a population of 6000, is situated on the shore of Lake Michigan, about 25 miles north of Chicago. It draws its water from Lake Michigan at a depth of about 20 ft. and 3300 ft. from shore, the average daily consumption being about 1,000,000 gal. per day.

At Glencoe, as in almost all modern plants today, chlorination is used as an additional safeguard to proper and efficient filtration. In July 1930, in order to utilize not only the germidical but also the oxidizing properties of chlorine, we went a step further and adopted the superchlorination process at our plant. The demand by the modern water consumer for a more palatable water, had made it necessary to furnish water not only safe against the slightest possibility of waterborne disease, but also free of all tastes and odors. Superchlorination we felt would accomplish this in the simplest and most economical way. This process as carried out in practice consists of pre-chlorination with large doses of the chemical, followed by dechlorination. The chlorine is applied to the water in excessive doses as soon as it enters the mixing chamber and remains in intimate contact with the water during its entire course through the plant until finally the excess chlorine is neutralized or removed just before the water is pumped into the service mains.

Although superchlorination has been known for a long time as a valuable method for oxidizing organic matter in water and for destroying tastes and odors, it has been only during the last five years that it has been used to any extent on a practical scale. The process, as carried out at our plant proved so successful and effective, so simple and foolproof, that it is surprising that more plants are not making use of it today.

As mentioned, before, the success of the superchlorination process depends on the power of chlorine as a strong oxidizing as well as sterilizing agent, and on the effectiveness of the dechlorinating agent used. Most objectionable tastes in water are produced either by the presence of certain types of algae or other microorganisms, by the presence of chemical or industrial wastes, or by the addition of chlorine. Chlorine may produce a taste in itself or make the other tastes more pronounced by forming other compounds. In superchlorination, however, when the chlorine is added to the water in excessive doses and a sufficiently long contact period is provided, the chlorine first combines with those organic substances which have an avidity for it and after this demand has been satisfied, the excess is available for destroying the taste-producing matter by what is generally assumed to be oxidation. Whether the excess chlorine oxidizes the aromatic substances or reacts with them to form odorless compounds is not known definitely, but the fact remains that the tastes disappear. It is important to have a sufficiently long contact period and for this reason superchlorination frequently entails super-prechlorination.

At our plant we have found that a dosage of from 1 to 1½ p.p.m. or 8 to 12 lb. per million gallons applied to the raw water is sufficient during 90 per cent of the time. Under ordinary conditions with a contact period of around six hours through the mixing basin, the coagulation basin and the filters, this dose gives us a residual of about 0.5 p.p.m.

Outside of exceptional periods this is the figure we try to maintain. During certain periods in June or September, however, when the tastes are more pronounced on account of the large number of micro-organisms which produce that fishy or cucumber taste, we sometimes have had to increase the dosage to 2 p.p.m. in order to retain a residual of 0.5 p.pm.

Generally speaking, our experience has been that by carrying a residual of 0.5 p.p.m. through the basin and filters all tastes can be eliminated. There has been just one exception to this rule and that has occurred just recently. Since the middle of November, 1931, the water has carried that musty, earthy, smoky, coal gas or what have you taste which caused so much complaint along the south end of Lake Michigan. We were able to eliminate this taste by increasing our dosage to 3 p.p.m. or 25 lb. per million gallons. This extreme dosage however, resulted in a residual of from 1½ to 2 p.p.m. in the filter effluent.

These figures probably sound very excessive to some of the operators who are used to working with very small residual chlorine figures, say up to 0.20 or 0.30 p.p.m. The constant fear of producing chlorine taste in case of overdosing in such plants is only natural. It is unfortunate that the worst tastes in chlorinated water are frequently caused by very small over-doses of chlorine; in other words, the worst taste zone is so close to the normal dose of chlorine required for sterilization that it takes only a small overdose to produce a very pronounced taste.

Howard at Toronto has successfully used superchlorination of Lake Ontario water since 1926. He uses as a dechlorinating agent, liquid sulphur dioxide. He ran into considerable difficulties however, in applying the sulphur dioxide through vacuum machines.

I believe that it was for that reason that Mr. Birdsall* conceived the idea, that if a dry powdered material containing available sulphur dioxide could be applied to the superchlorinated water easily and inexpensively by

*Member, Board of Water Commissioners, Glencoe, Ill.

means of a dry feed machine, superchlorination would become more successful and more commonly used as a means of destroying tastes and odors in public water supplies.

There are several chemicals containing available sulphur dioxide (SO_2) that could be used. Sodium Hyposulphite contains approximately 25 per cent; Sodium Sulphite about 50 per cent, and Anhydrous Sodium Bisulphite about 65 per cent. The latter is a free flowing powder, suitable for use in a dry feed machine and is readily soluble in water. It is also the least expensive and most efficient. One part of residual chlorine is neutralized by 1.6 parts of sodium bisulphite [$Na\ H\text{-}SO_3$].

This is the material used in our process. We feed it into the suction well of the high lift pumps by means of a rotary Omega dry feed machine, which was especially designed for this material and this plant (see illustration).

Dechlorination is a fool proof method, because about all the operator has to know is how to make residual chlorine tests with orthotolidin. We make these tests every hour for the filter effluent and the tap water. An excess of bisulphite can be used with safety because in itself it produces no tastes in the water nor has it any other after effects. This makes it a very practical material to use, because if too much is added no harm is done; and if too little is used, the chlorine begins to show in the tap water and it is only necessary to speed up the feed.

In conclusion I wish to state that this method has proven entirely satisfactory and that we haven't come across any tastes that we have not been able to eliminate.

Acknowledgment.—The above paper was read at the December meeting of the West Shore Water Producers Association.

▼

New Literature

"Modern pH and Chlorine Control"

W. A. Taylor & Co., Inc., of 872 Linden Ave., Baltimore, Md., have had prepared a treatise on "Modern pH and Chlorine Control"—setting forth the most up to the minute understanding of each subject.

In the language of the *foreword* of this publication: "The principal purpose of this book is to render the greatest possible service to everyone interested in pH and chlorine control. In addition to listing the most modern and practical equipment, we have given considerable practical information collected by members of our staff during eight years of specialization in work of this nature."

The work has particular significance when its authorship is revealed as being that of authorities in the field —W. A. Taylor and F. R. McCrumb. It contains a simple explanation of the meaning of pH control, a technical discussion of the subject, its application to more than thirty research and industrial problems and the approximate pH values of over one hundred acids, bases, foods, etc.

It discusses modern practices in chlorination, its control in the treatment of water, sewage trade wastes, etc., and in the manufacture of food products as well as bleaching of textiles, pulp, etc. Equipment for determining pH value and available chlorine is illustrated and described.

The 50-page book has been prepared for free distribution and a copy will be sent upon request to W. A. Taylor & Company, 872 Linden Ave., Baltimore, Md.

Valuable Data on Friction Through Cement Lined Pipes

In a new booklet recently published, the Engineering and Research Department of the American Cast Iron Pipe Co., at Birmingham, Ala., has supplied a table which contains new values of "C" when applied to cement-lined pipes. These values are to be applied when using pipe friction tables (derived from William's and Hazen's formula) for estimating friction created by varying rates of flow through cement lined pipes.

The A C I P C O engineers arrived at the new values for "C" after a number of actual tests employing various sizes of cement lined pipe vs. ordinary pipe. As compared with 100 for ordinary cast iron pipe a value of 145 for "C" appears conservative for cement-lined pipes and is not lowered with increasing age of the pipe.

The table on page 9 of the booklet—"Cement Lined Cast Iron Pipe"—contains the inside diameters of various sizes of cement-lined pipe, the respective values of "C" and carrying capacities. Such a table should prove useful to engineers and water works men and can be obtained gratis from the American Cast Iron Pipe Company.

▼

Simplex Valve & Meter Company Distributes New Bulletins

Bulletin 42: The Simplex Meter, Model M.G.O., is described and illustrated in which simplicity of design and accuracy is stressed as a major virtue in producing a direct reading flow scale and charts with flow totalization. The mechanism and its operation is thoroughly described. It is equipped with electric clock when desired. Other advantages found in the Model M.G.O. equipment are described and illustrated. The standard Simplex Meter Register, Model M. G. O., is designed to suit a mercury deflection of as much as 9.24 in. Other variations of that model are available for maximum deflections of from 1.90 in. to 19.0 in.

Bulletin 50: Simplex Gauges of various types are described and illustrated. Simplex illuminated dial gauges such as installed in the filtration plants at Saginaw, Michigan, Buffalo, Baltimore, Kansas City, Philadelphia, Detroit, Fort Worth and elsewhere are illustrated. Many styles of indicating and recording heads are illustrated and it is stated that the application of the Simplex Shaped Float which rests in the mercury pot transmitting the differential heads used in the loss of head or rate of flow measurements constitutes a distinct advance in the art and in water works equipment.

Copies of Bulletins 42 and 50 are available upon request from The Simplex Valve and Meter Company, 68th and Upland Streets, Philadelphia, Pa., or any district office.

▼

UNEMPLOYMENT RELIEF BY SEWERAGE CONSTRUCTION.—Batavia, N. Y., is planning the construction of additional trickling filters to its existing sewage treatment works which is at present a needed improvement. Olean, N. Y., will construct trunk sewers and sewer extensions will at the same time be made. Both cities are undertaking these improvements as a measure toward unemployment relief and each has made appli- a proportionate share of the amount to be expended for cation to the State Commission on Unemployment for labor required.

WEATHER CYCLES AND THEIR CAUSES*

By HALBERT P. GILLETTE

WHEN I began a research on weather cycles, five years ago, I adopted the hypothesis that sunspots are magnetically generated by planets, and that the magnetism of the sunspots causes terrestrial air disturbances. Later it became apparent that while sunspots are responsible for some of the minor periodic disturbances of our atmosphere, the main disturbances are probably due to the magnetic forces of rotating electron shells that encase the larger planets and the sun and moon.

In my initial study of sunspot and weather cycles I relied upon inspection of curves, both smoothed and unsmoothed. It was some time before I realized that there are so many cycles that the curve inspection method is of little value in finding the way through this maze. This led to my adopting the method of finding hidden cycles that was originally proposed by Balfour Stewart. Let us call it the Stewart cyclogram analysis. The best known example of such a cyclogram is any curve of average monthly rainfall that shows symmetry and one or more maxima or peaks.

Let it be assumed that it is known that there is a sunspot cycle of 11.2 yrs. and that it is suspected that there is a precipitation cycle of half this length, or 5.6 years. Assume that a peak of the sunspot cycle was in 1928.5. Then since 14 cycles of 5.6 yrs. is 78.4 yrs., there should be a rain peak in 1928.5—78.4=1850.1. Successive peaks of the assumed rain cycle of 5.6 yrs. would then occur in:

1850.1	1883.7
5.6	5.6
1855.7	1889.3
5.6	5.6
1861.3	1894.9
5.6	5.6
1866.9	1900.5
5.6	5.6
1872.5	1906.1
5.6	5.6
1878.1	1911.7
5.6	5.6
1883.7	1917.3

Having thus derived the dates, set up in the first column of Table I the date of the year nearest each of these dates. In the second column enter the San Francisco rainfall in tenths of an inch, for the "seasonal year" ending June 30, 1850. The number so entered is 33.1, for the rainfall was 33.1 inches. In the following seasonal year, 1851, it was 7.4 ins., hence 7.4 is entered in the next column (the column headed 1), and so on. The available data enable us to complete 14 cycles of 5.6 yrs. each. We have 6 columns. This is the nearest whole number to our assumed 5.6-yr. cycle. Moreover, our assumed "peak" dates in the first column are only approximate. Hence the resulting totals of these 6 columns can give only an approximation. But such an approximation is close enough for practical purposes where many cycles are covered by the available data. Both the totals of the six columns and their averages disclose good evidence of a 5.6-year cycle whose main peak is in column 0, with a secondary main peak in column 3, indicating a cycle of 2.8 years.

The resulting cyclogram curve is not perfectly symmetrical, but it approaches thereto as nearly as should be expected where only 10 cycles of rainfall are involved.

By using the annual ring thicknesses of the Arizona pines, measured by Douglass, a period of more than 500 years becomes available; and the 5.6-year cycle discloses itself most convincingly in cyclogram analyses like those of Table I.

It follows from such analyses as these that the 11.2-year sunspot cycle has its counterpart, and also a semicycle of 5.6 years, in precipitation, and tree growth.

Fig. 1 shows 9 cyclograms based on an assumed cycle of 11.203 years. A semicycle of 5.6 years is to be seen in nearly every case except for sunspots and auroras. The cyclogram curves in Fig. 1 were derived from analyses similar to that in Table I, except that the table contained 11 columns of annual data.

By excluding the 7 cycles of sunspot numbers in which at least one year averaged 100 spots or more, the remaining 9 cycles gave a curve even more symmetrical than when the entire 16 cycles were used as the basis of the cyclogram. See curves A and B, Fig. 1. This was to be anticipated for there are several other sunspot cycles than the 11.203-year cycle whose amplitude is greater and whose length is longer.

This method of effecting improvement in the symmetry of the 11.2-year sunspot cyclogram suggested excluding all cycles of Arizona pine rings in which any ring showed a growth exceeding one millimeter. Curves H and I show a similar improvement in symmetry, and an increase in amplitude.

The most remarkable improvement of this sort was obtained when a 12-month sunspot cyclogram analysis was made; for by excluding every month in which 100 or more spots occurred, and averaging the remaining 12 months in the table, a cyclogram of great amplitude and excellent symmetry resulted, the "peak" month being March and the "valley" month, September.

Nearly all sunspot cyclograms can be improved in symmetry by the exclusion of extremely spotted periods. Rainfall cyclograms, however, are less apt to show increased symmetry as a result of excluding days, months, or years of exceptionally heavy rainfall.

Some of the curves of Fig. 1 show not only a semicycle of 5.6 years but a quarter-cycle of 2.8 years. To bring these out very clearly it is necessary to use the month as the time unit instead of the year. In this way I found a cycle of $\frac{1}{8} \times 11.2 = 1.4$ month in sunspots, rainfall, etc. This is the subcycle of the 11.2-year cycle, whose probable cause will be given later.

The annually deposited clay laminae, called varves, that were laid down in ancient glacial lakes, resemble tree-rings in appearance. I have found that they fur-

*Mainly an abridgment of a paper read before the American Meteorological Society, June 18, 1931.

nish an even better "rain-gage" than that of the annual rings of the Arizona pines. The longest and best measurements of American varves are to be found in Antevs' "Recession of the Last Ice Sheet in New England" (1922) and in his "The Last Glaciation" (1928), published by the American Geographical Society, New York City. (These books are $1 each.) The tree-ring measurements of Douglass are given in "Climatic Cycles and Tree Growth," Publication No. 289, of the Carnegie Institution, Washington, D. C., now out of print but available in many public libraries.

No study of the longer weather cycles should be undertaken without applying the Stewart cyclogram method to varves as well as to tree-rings.

I have found that each of the 9 large planets causes sun-spot and weather cycles. Each planet causes at least spot and weather cycles. Each planet causes at least four cycles, as shown in Table II. There is a cycle exactly equal to the orbital period of the planet, which usually has such slight amplitude as to be difficult of detection unless many cycles are used in the cyclogram analysis. The main cycle caused by each planet is slightly shorter than its orbital period. I infer that the main cycle is caused by the magnetic field of one or more rotating shells of electrons that encompass the planet. The well known Kennelley-Heaviside layer that reflects radio waves, and makes broadcasting possible, is such a shell. Let the poles of such a shell rotate clockwise slowly around the axis of the planet, and the north pole will point most directly sunward slightly oftener than once every orbital period of the planet.

The outer electron shells that surround the sun are apparently not concentric with the sun, which explains why only the north pole of a planet field causes sunspots. Whereas, in the case of the earth, the electron shells are apparently nearly concentric with the earth, so that either N or S pole of a planet field produces sufficient distortion or displacement of the earth's electron shells to result in the flows of electrons that cause air currents and tend to cause storminess.

The main cycle caused by a planet is exactly harmonic with its orbital period, which explains the existence of a supercycle. Thus the earth causes a sunspot cycle of 12 months and one of 10.5 months.

$$7 \times 12 = 84 \text{ mos.} = 7 \text{ yrs.}$$
$$8 \times 10.5 = 84 \text{ mos.} = 7 \text{ yrs.}$$

This explains the 7 yr. sunspot cycle that Schuster discovered and the 7 yr. weather cycle that has been commented upon so often by meteorologists. There is also a weather cycle of 3.5 years, or a semi-supercycle; and one of 21 mos., or a double main-cycle. Double main-cycles and semi-supercycles are caused by most of the planets named in Table II.

There are also hypercycles 8 times the length of the supercycles.

Each planet causes a subcycle that is either 1/8th or 1/12th, or an integral multiple thereof, of the length of the main-cycle. This may be due to a periodic nodding of the axis of the electron shell that encases the planet. The earth's axis nutates or nods periodically, as a result of gravitative forces. Evidently the axis of an electron shell nods periodically under magnetic forces, causing subcycles and hypercycles.

An electric current in the presence of a magnetic field tends to cause rotation of nearby neutral but magnetic molecules, the rotation being around the axis of the current and its direction being dependent upon whether the N or S pole is nearest, and upon the direction of the current.

The oxygen of the air, as Faraday discovered is magnetic. Hence it can be made to rotate. The direction of rotation of the air depends on the direction of the current of electrons, that is, whether the current is escaping from the earth upward or is flowing down into the earth.

Hence I have come to the conclusions that ascending spirals of air are examples of what Faraday called "magnetic rotation." It is not unlikely that practically all air currents that characterize rain cycles are electrodynamic phenomena.

For more than 30 years it has been known that electrons act as nucleii upon which moisture tends to condense. Clouds tend to occur in layers, which seems to indicate that there are several shells of electrons not far above the earth. Any emission of electrons from the earth must assist in cloud formation.

The last lunar supercycle 9.5-year peak was 1928.55; and its last hypercycle (76-yr.) peak was 1871.55. There was a semi-hypercycle peak 1909.55. The semi-hypercycle rain peaks are about as high as the hypercycle peaks, thus giving a cycle of 38 years. There are also high semi-supercycle peaks, thus giving a lunar rain cycle of 4.75 years.

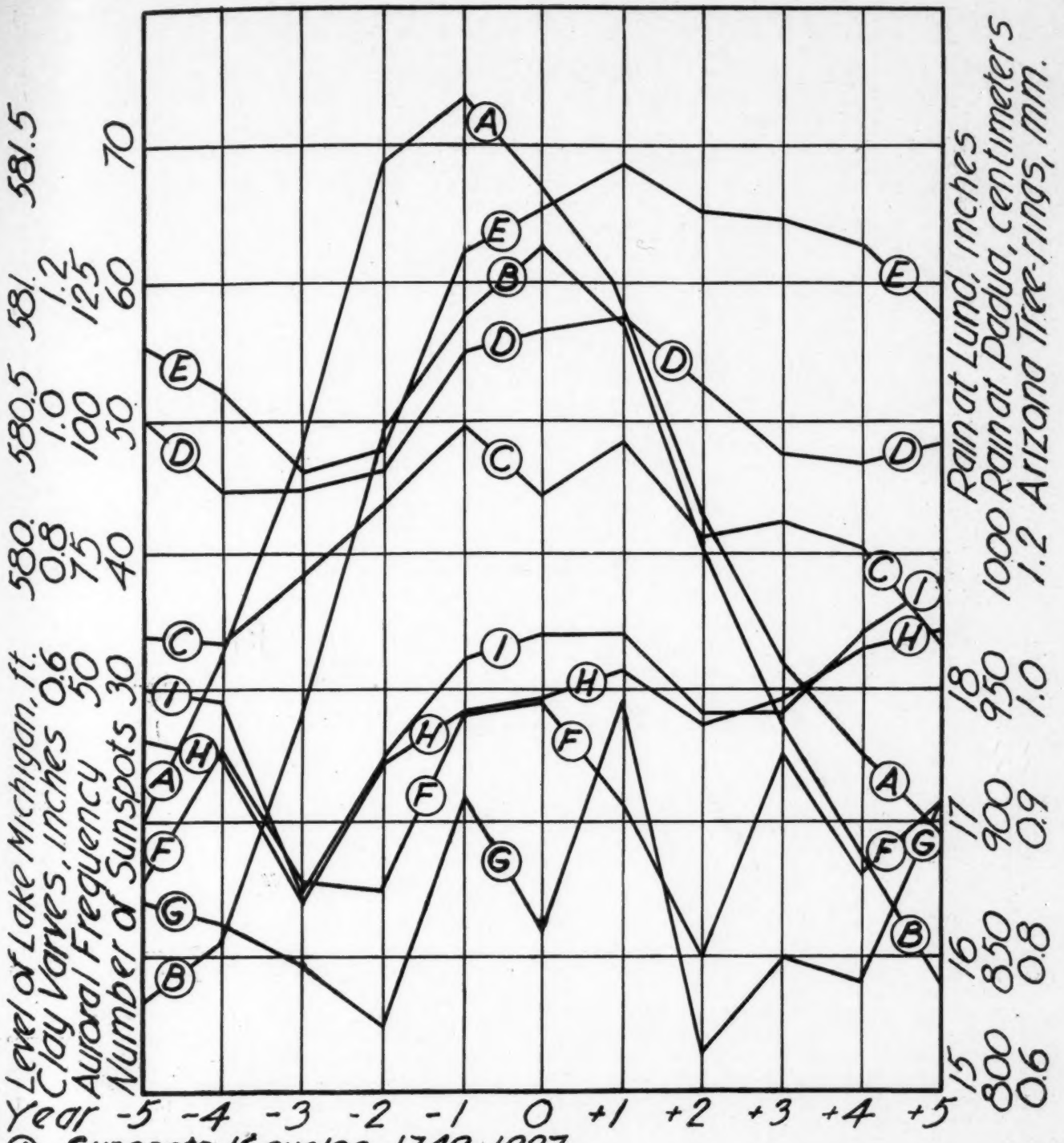
The moon, in common with the planets, causes changes in the elevation of the earth's electron shells in two ways: (1) Tidal deformation, and (2) eccentric displacement of the electron shells. The electron shells of the earth are rotating anti-clockwise and so are those of the moon. Hence, the electrons in the nearest face of the moon's shells magnetically repel those in the nearest face of the earth's shells, and attract those in the farthest face. This is in accord with Ampere's law of electric current repulsion and attraction. The result is a tidal deformation of the earth's shells, the crests of the tidal waves being about 90 degs. of longitude away from the line joining the centers of earth and moon. This tide occurs every semi-lunar day or every 12.42 hrs. In similar manner the sun causes a 12-hr. tide in our electron shells, which explains the 12-hr. barometric law, the 12-hr. deflection of the magnetic needle, and the 12-hr. variation in the electric potential of the atmosphere. When these two magnetic tidal crests in the earth's shells coincide, as they do every ½x29.53 days, there is a maximum uplift of the shells a great outflow of electrons from the earth as a result of reduced electric pressure, and a strong tendency for rain to fall. In Portland, Oregon, the rain peaks lag about two days behind the theoretical date of these tidal peaks.

Eccentric displacement of the earth's electron shells is greatest when the axis of an electron shell of the sun, moon or a planet points most directly earthward. On March 8 and Sept. 8 the sun causes great eccentric displacement of the earth's electron shells. Other similar displacements caused by the sun will be discussed in a later article.

Many of the cycles in Table II are about the length of weather cycles that have been found by previous researchers, notable among whom is Dinsmore Alter.

Synthesis must follow analysis in order to forecast rainfall. Because of the great number of weather cycles, synthesis will be no easy task. Local electric and magnetic conditions will add to the difficulty of the problem. Other difficulties will disclose themselves. But before weather forecasting can become a science, it is essential not only that all the important weather cycles be determined with accuracy but that their causes be known.

Doubtless there are other cycles than those given in Table II. In any event the method of finding them is



Ⓐ = Sunspots, 16 cycles, 1749-1927
Ⓑ = Sunspots, 9 cycles, after deducting cycles containing 100 sunspots
Ⓒ = Auroras, 11 cycles, 1749-1871 (Encyclopedia Britannica)
Ⓓ = Varves, 50 cycles, Antevs Nos. 3998-4557
Ⓔ = Level of Lake Michigan, 7.4 cycles, 1860-1930
Ⓕ = Rain at Lund, Sweden 14 cycles, 1749-1905
Ⓖ = Rain at Padua, Italy, 17 cycles, 1727-1916
Ⓗ = Arizona Pines, 45 cycles, 1402-1905
Ⓘ = Arizona Pines, 35 cycles, after deducting cycles in which any ring exceeded 1 m.m. thickness.

Fig. 1.—Nine Cyclograms Based on An Assumed Cycle of 11.203 Years

simple, and it can now be successfully applied with speed by using two principles. First, the principle that the main cycle (t) caused by a planet approximates to a function of its orbital period (T) and its orbital velocity in miles per second (v), as given by

$$t = T(1 - 0.007v)$$

Second, by applying the principle that all the cycles caused by a planet are perfectly harmonic with its orbital period, the exact length of a cycle may be ascertained.

The cycles caused by two different planets are never perfectly, but always approximately, harmonic. Thus the 7 year super-cycle due to the earth is very nearly harmonic with the main cycle caused by Jupiter, for:

$$8 \times 7 = 56.000$$
$$5 \times 11.203 = 56.015$$

The inference is that when the planets were generated their orbital periods and all the cycles (sun-spots, etc.) due to them were perfectly harmonic, but have subsequently departed from perfect harmony because of slight changes in their orbital periods. "The harmony of the spheres" turns out to have been more than a poet's dream or a philosopher's idle speculation.

Pluto's orbital period is estimated by astronomers to be approximately 252 years but tree-ring and varve cycles indicate the length here given.

Apollo is the name assigned to a planet as yet not recognized by telescopic observation yet clearly evident in tree-ring and varve cycles.

TABLE I—CYCLOGRAM ANALYSIS SHOWING 5.6-YEAR RAIN CYCLE SAN FRANCISCO, CALIF.

Seasonal	Years After Date					
Year	0	1	2	3	4	5
1850	33.1	7.4	18.5	35.3	23.9	23.8
1856	21.7	19.9	21.8	22.2	22.7	19.7
1861	19.7	49.3	13.7	10.1	24.7	22.9
1867	34.9	38.4	21.4	19.3	14.1	30.8
1872	30.8	15.7	24.7	20.6	31.2	11.0
1878	35.2	24.4	26.7	29.9	16.1	20.1
1884	32.4	18.1	33.1	19.0	16.7	23.9
1889	23.9	45.9	17.6	18.5	21.8	18.5
1895	25.7	21.3	23.4	9.4	16.9	18.5
1900	18.5	21.2	19.0	18.3	20.6	23.5
1906	20.4	26.2	17.4	25.6	19.5	25.5
1912	14.1	12.0	29.6	27.4	27.1	15.8
1917	15.8	11.5	25.6	10.5	23.2	19.9
1923	22.2	11.6	30.8	20.7	25.4	19.6
Average	27.4	20.0	21.5	23.6	19.9	24.0

Note: The rainfall is given in inches for the "seasonal year" ending June 30, instead of the "calendar year" ending Dec. 31; because San Francisco's seasonal rain peak is usually in midwinter. The rainfall for the 12 months ending June 30, 1850, was 33.1 inches. That in 1851 was 7.4 inches, and so on, as shown above. Not only is the 5.6-year cycle disclosed, but one of about half its length, or 2.8 years.

TABLE II—WEATHER CYCLES

Causative Planet	Orbital Period Years	Main Cycle Years	Subcycle Years	Supercycle Years	Date of a Peak
Mercury	0.2408	0.1926	0.0321	4.8160	1928.16
Venus	0.6152	0.5383	0.0673	4.3064	1927.43
Earth	1.0000	0.8750	0.0729	7.0000	1925.56
Mars	1.8808	1.5046	0.3761	7.5232	1929.18
Jupiter	11.862	11.203	1.4004	201.654	1906.06
Saturn	29.457	27.821	9.2735	500.77	1907.7
Uranus	84.013	81.212	10.1515	2,436	1869.6
Neptune	164.783	161.487	13.457	8,074	1836.9
Pluto	255.25	251.85	31.48	18,888	1847.8
Apollo	646.9	634.0	52.83	31,700	1778.4

Note: Except for planets whose orbital period exceeds that of Saturn the "Date of Peak" is that of the last supercycle peak, which is also a peak date of the other cycles.

Since the foregoing article was written, I have found a precipitation and sun-spot cycle of exactly 14 months. It is perfectly harmonic with the 7-year cycle, and is therefore due to an electron shell encasing the earth. The poles of this shell must rotate anti-clockwise around the axis of the earth, making a complete revolution in 7 years. The 14-month cyclogram discloses a 2-month cycle.

Since the large planets closely resemble one another as to the cycles that they cause, it is highly probable that each of them resembles the earth in causing a cycle somewhat longer than its orbital period. I have not yet completed this investigation.

The moon causes a cycle of precipitation equal to the length of its siderial period and one slightly shorter, and a supercycle of almost exactly 9.5 years. Thus,

$$127 \times 27.32166 = 3469.85 \text{ days} = 9.5 \text{ years}$$
$$128 \times 27.10821 = 3469.85 \text{ days} = 9.5 \text{ years}$$

It also causes a precipitation cycle equal to its synodic period of 29.5306 days, and one of ¼ that length. Cyclograms of daily precipitation at Portland, Oregon, from 1872 to 1932, disclose this cycle very clearly. Evidently the moon has rotating electron shells that cause a semi-lunar day (12.42 hr.) tide in the earth's electron shells and when this lunar tidal crest is assisted by the 12-hr. tide caused by the sun, electrons escape freely from the earth and tend to cause rain. At Portland the precipitation peaks lag about 2 days after the full moon, the change of the moon and the quarters. Since there are scores of cycles beside these, it is not to be expected that precipitation will occur with regularity at the lunar peak periods. Juneau, Alaska, precipitation also shows the lunar cycles.

Meteorological authorities have been so positive that the moon causes no weather cycles that not until recently did I undertake cyclogram analyses to find possible lunar cycles. In a later article the lunar cycles will be discussed in detail, and lunar cyclograms will be given.

▼

Chicago Wants A.W.W.A. Convention in 1933

Preliminary steps have been taken to bring the American Water Works Convention to Chicago in 1933 in conjunction with the World's Fair which will at that time be under way in the "Windy-City."

City Engineer M. B. Reynolds called a luncheon meeting of the members of the A. W. W. A. living in the Chicago metropolitan area. The object was to discuss the prospects of bringing the convention to Chicago. After listening to talks made by officials connected with the city administration, the World's Fair, the Association of Commerce and the "Century of Progress Exposition" on motion of C. B. Burdick, Chairman of the Illinois Section of the A. W. W. A. the 35 members present voted unanimously to have a committee appointed to start negotiations in this direction with the parent association. The following members constitute the committee selected. Chas. B. Burdick, Chairman, W. W. DeBerard, A. E. Gorman, Paul Hansen, C. R. Knowles.

▼

SEWAGE TREATMENT FOR TARENTUM, PENN.—Land has been purchased for construction of a new sewage treatment plant at Tarentum, Penn., to serve in addition Harrison, Brackenridge and Frazer. By early construction the towns involved expect to save $15,000 on the installation because of the present low labor cost.

SECOND ANNUAL ARKANSAS WATER WORKS CONFERENCE

THE second annual Arkansas Water Works Conference was held in the University of Arkansas at Fayetteville, Ark., on Feb. 17, 18, and 19. This conference, organized through the cooperative efforts of the State Board of Health and the Departments of Engineering and Chemistry of the University, bids fair to become one of the outstanding state conferences in the country. The principle topics discussed concerned economies in water works operation and correction of "leaks" and losses.

The members, and guests of the Conference were welcomed to the University by Dean **W. W. Gladson** of the Engineering College who explained some of the extension work carried on by the Engineering College. Professor **O. M. Smith** of the Department of Chemistry, University of Oklahoma, presented an exhaustive paper on the subject **"Filtration of Water."** He detailed the functioning of filters and described the action of alum "floc" and the action of biological growths in forming sand coatings. Descriptions were given of the way in which mud balls, hard spots and cracks form in filter beds. The use of rapid vertical rise of wash water to keep the sand grains clean was described. In the discussion ensuing, the use of sloping filter walls to prevent shrinkage of the sand bed away from the side walls was suggested.

Prof. **R. G. Paddock,** head of the Mechanical Engineering Department at the College discussed **"Industrial Uses of Water."** He said that it was rare to find a public water supply especially adapted to industrial requirements and that cooperation between industry and the waterworks department would result in a better understanding of each other's problems and needs. He dealt with the use of water in boilers, naming the scale forming constituents, and commented on trouble from corrosion and caustic embrittlement with too alkaline waters. He said that in power plant work the cooling water passing through condensers gave rise to biological growths which caused lowered efficiencies by reduced vacuum production. Control of these growths by intermittent chlorination of the water had proven profitable.

In ice manufacture, methods of treating the water so as to prevent dirty cores and shattering were described. The removal of iron was listed as necessary in many industrial processes. Paper mills, textile mills, laundries, etc., needed water free of suspended matter and relatively soft. The desirability of softening hard public water supplies was stressed. Attention was directed to the corrosive action of dissolved gases in some waters.

At luncheon, the Conference was addressed by President J. C. Futrall of the University and Director A. M. Harding of the Extension Division. Their general topic was the modern needs in education and how the University of Arkansas was fulfilling them.

Pumping Plant Losses

L. A. Jackson, Assistant Superintendent of the Arkansas Water Company at Little Rock, delivered a very carefully prepared paper on **"Economies at Steam Plants."** He described the boiler room operation as the largest plant expenditure, with fuel charges amounting to only about 10 per cent. With the very low efficiencies in steam plants it is necessary to be careful all along the line. Mr. Jackson said further: Fuel should be fed to fire-boxes frequently and in small quantities to maintain a thin bed of fire. Draft regulators should be employed and steam pressures kept uniform. Soot should be removed from the tubes and scale kept at a minimum. Feed water should be mostly condensate and the make up water should be softened. He stressed the importance of accurate daily plant records and the necessity of daily calculations of steam plant efficiency. This record promotes personnel interest and where several stations are in competition with each other, increased attention to losses, etc., will result. He outlined the method of figuring "duty" and overall thermal efficiency and indicated the desirability of placing steam plant operation on a competitive basis—with each station attempting to equal or better "Par" as is done in the game of golf.

R. R. Pittman, Engineer for the Arkansas Power and Light Company at Pine Bluff, gave a general talk covering his wide experience in selection of proper motive driven pumping units. He said, that many plants are today forced to operate their present equipment regardless of its economy and he therefore dwelt largely on economies that could be effected with existing equipment. He described pump characteristics and stressed the economy in the proper selection of pumping units for the work to be done rather than a purchase on basis of initial cost.

Professor **W. B. Stelzner** in his excellently prepared paper on **"Electric Power for Water Plants"** described losses in motors, transformers and distribution systems. He described how losses could be reduced to a point where the increased carrying charges on capital invested more than offsets the savings effected. **J. C. Black,** Manager Southwest Gas and Electric Company at Rogers, Arkansas, in discussion, made some additional comments covering electric motors.

Evening Session

F. C. Puckhaber of Wallace and Tiernan Company, gave an illustrated talk on **"Pollution Hazards of Ground Water Supplies."** From the evidence taken from case records it seemed conclusive that all well waters should be at least chlorinated as a safeguard against chance or unforeseen contamination. **Egmont Smith,** Dallas Manager, Neptune Meter Company, presented some pertinent facts concerning **"The Reduction of Waste Water by Metering."** Mr. Smith stressed the fact that large capital expenditures might often be saved by metering, because this reduces wasted water consumption. He mentioned the extra credit given by the Texas Fire Underwriters for metered supplies. Increased revenue and reduced pumpage with saving in pumping bills, etc., came about as the result of metering. The desirability of installing plant meters to check output and the intelligent care and use of meters was stated as indicative of

good management. Proper selection of meters to record low flows was stressed.

Distribution and Treatment Plant Losses

E. M. Ratliff, Superintendent Fayetteville Water Company, outlined in detail **"Distribution System Losses"** in the Fayetteville system. The source of supply is the White River, two miles from the city. The raw water is pumped to the filter plant. Water is measured at the river pumping station and every use of water in and about the purification plant is recorded. The filtered water is not corrosive and meters are not corroded. Losses through main leakage, hydrant usage for fire and street flushing, evaporation from basins, amount used in cleaning, etc., were listed. Under registration of meters had been charged with a loss of nearly 33 million gallons a year, representing about 41 per cent of the unaccounted for water. **N. E. Nunn,** Superintendent of the Van Buren Water Company, discussed Mr. Ratliff's paper and mentioned practices at Van Buren to stop losses. The city owns the meters and services and cut-offs are at the mains. All services are metered and the meters are kept in good repair. **H. J. Darcey,** Chief Engineer, Oklahoma State Board of Health, reported the use of a siphon to remove sludge from settling basins continuously, which had saved water wasted in dewatering and flushing out basins with fire streams.

George D. Suter, Chief Engineer, Arkansas Fire Prevention Bureau, Little Rock, presented an excellent paper on **"Distribution Losses Due to Pipe Friction"** which dealt with the fire demands on a distribution system and troubles encountered in getting satisfactory flows. He outlined the studies conducted by the Bureau in an effort to improve conditions and what had been found. He advocated Pitometer Surveys and said also that hydrant flows and pressure records could be used to good advantage. The use of mains less than 6 in. should not be tolerated. Systematic flow tests are desirable—they indicate need for systematic extension, reveal open or closed valves, and may indicate the necessity for larger mains with lower pumping costs, etc. **N. E. Nunn** stressed the need of clean mains and the care which should be exercised in construction to remove pipe obstructions. The value of exact valve location records and testing was stressed.

A. E. Skinner, of the Pitometer Company, contributed a paper on **"Waste Water Surveys"** which was read by Professor W. R. Spencer. Pitometer studies are almost indispensable if one is to account for all water pumped. They reveal large losses, illegal use of water, check up large consumers, test out large meters and reveal information as to the condition of valves and mains. Often the survey discloses 10 to 50 per cent of total pumpage is going to waste in one way or another. **Professor Spencer** then outlined the Pitot tube development and the present use of this device for flow measurements. He described other methods for leak detection such as metered bypasses around valves, sound detectors, measurement of sewage flows, etc.

Treatment Plant Losses

Dr. Harrison Hale of the Department of Chemistry of the University presented a paper advocating chemical supervision of treatment works—the title being **"Waste of Chemicals in Water Treatment."** Adequate chemical control, he said, would more than pay for itself in the savings on chemicals used and improvement of product. A non-corrosive water can be produced and the quality greatly improved. With proper supervision, public confidence in the plant increases and accurate plant records, so necessary for plant protection, will result. **A. H. Ullrich,** Chemist, Fort Smith Water Company, in discussing Dr. Hale's paper, outlined some of the more frequently used tests and stressed the need for proper coagulation. By minor changes at Fort Smith a very material saving in chemicals used had been effected. He stressed the need for adequate records and held them indispensable for efficient plant operation. They reveal the careless and wasteful operator and benefit the good operator.

Tastes and Odors

M. Z. Bair, State Sanitary Engineer of Arkansas, spoke on **"Odors and Tastes"** in hopes of opening up a general discussion on this important subject. He said that a number of complaints had been registered with his office and the public health aspects of the matter had caused careful consideration of the problem. He favored the use of heavy chlorination and removal of the excess with activated carbon, and had the endorsement of the State Board of Health. **R. R. Pittman** stated the problem at Pine Bluff and reported that ammonia chlorine treatment had not proven successful. He had not tried activated carbon before the trouble had cleared up.

Charles Trowbridge, Chief Sanitary Engineer, American Waterworks & Electric Company, New York City, spoke concerning **"The Use of Activated Carbon."** He cited experiences with powdered activated carbon at 10 plants operated by the American Water Works Company. He said, that the point of application and dosage had been varied to suit local plant conditions. Powdered activated carbon had proven very successful in removing tastes due to industrial wastes such as phenol, etc., and he thought it incumbent on purveyors of water to produce the best possible product. **W. H. Vaughan,** of Fort Smith, described conditions created by sorghum wastes on the Fort Smith Water shed.

Management Losses

Lloyd Rebsamen, Superintendent City Water & Light Plant at Jonesboro, presented a detailed paper covering **"Cost Accounting and Records."** Mr. Rebsamen stressed the need of adequate cost accounting. Meters, he thought absolutely necessary, as was also a rigid enforcement of department rules as to cutting off water service for non-payments. For business reasons he favored monthly billing. **W. H. Vaughan** outlined the system used at Fort Smith, indicating why such a commendable system as that employed at Jonesboro could not be used in Fort Smith. He mentioned that comparisons are seldom possible due to local conditions and that city costs can seldom be placed on a comparative basis.

The following new officers were elected for the coming year: L. A. Jackson, Chairman; Harry E. Nunn, Vice Chairman; Dr. Harrison Hale, Secretary.

A novel pamphlet, "The Coagulator," was mimeographed by the Chemistry Department of the University and distributed daily during the meeting.

Ed. Note—The papers read at this Conference are to be printed in a Bulletin to be distributed by the University of Arkansas.

EDITORIALS

Sewage Works Associations

SEVENTEEN years ago under the sponsorship of the Engineering Division of the New Jersey State Health Department, a very small group of men with a common interest formed what is now known as the New Jersey Sewage Works Association. Thus a pioneer movement was started in America for the purpose of improving the status of the art of sewage handling and the propagation of knowledge concerning treatment of sewage. In those days the two-story tank of Dr. Travis had not long since bowed to an improvement by Dr. Imhoff. The Emsher (Imhoff's) tank was being hailed as the last word in sewage treatment devices. The largest plant in America—that at Baltimore—had just been completed and there the new Imhoff tanks, as well as those in New Jersey and elsewhere supplied problems which sufficed for many hours of argumentation and discussion. "Foaming," then as now, was a problem of universal interest. The depth of tanks, the hardness of the water supply, the effect of laundry water, the area of gas vents, and in fact most everything save "acidosis" was held by one or another to account for the fact that these improved tanks had seemed to be working upside down in all too numerous instances.

Another topic discussed in the early meetings of the New Jersey Association, then as now, was the little pest—the filter fly (*Psychoda alternata*). These discussions did not fall upon deaf ears. The interest of Dr. T. J. Headlee, of the New Jersey Agricultural Experimental Station, was aroused and shortly after the birth of the association he began his studies of the biology of the sprinkling filter. The outgrowth of that one-man start was the passage of an act of legislature in 1920 creating a "Sewage Substation" in order that joint studies by the State Department of Health and the Agricultural Experimental Station might be made of the biology of sewage treatment. With an appropriation of $10,000 per year laboratories were equipped at Rutgers University in 1921. What has resulted from that start is covered in the ten annual reports printed and the voluminous material from that station which has been published in technical magazines and journals.

The point to this story is that this extensive and fruitful research in the realm of sewage disposal was largely made possible by the efforts of the New Jersey Sewage Works Association which in turn were fostered by the State Department of Health.

A good many years intervened between the formation of the New Jersey Association and that of other similar groups, but within recent years the movement has grown rapidly and with significant effect in the matter of improved status of the art of sewage disposal and a better understanding of the scientific phases of treatment. The Federation of Sewage Works Associations now only about four years old is composed of 16 of the individual associations which now are functioning in America. The Federation boasts of 1,434 members and its official organ, *Sewage Works Journal*, reaches 1,700 subscribers.

The increasing importance of sewage and sewerage comes to light in recent reports of the F. W. Dodge Corporation covering 37 states east of the Rocky Mountains. In 1931 the following contracts in excess of $10,000 each were reported:

	Projects	*Costs*
Sewerage	2,057	$88,329,400
Water Works	1,112	44,829,900

That is quite indicative that the public is rapidly becoming sewage conscious and emphasizes the trend of developments in the field of sanitation. Sewage Works Associations are contributing their share toward such developments.

▼

Receivers and Red Ink

THE purveyor of water who finds himself confronted with collection of water bills (in arrears) from receivers managing foreclosed properties will have a problem on his hands when it comes to collecting. A precedent has been set in such a case in the state of New York just recently.

In this, the property consisting of an apartment house, which at the time of foreclosure and appointment of a receiver, had a water bill against it to the amount of $711. The water company in attempting to collect from the receiver and being unsuccessful had served notice that service would be discontinued unless the bill was paid. The receiver agreed to pay for water taken since his appointment but not prior thereto.

Supreme Court Justice Dike, after hearing the case, held that the receiver of an apartment house was not liable for a water bill incurred by the former owner and that the water company had no right to discontinue service even though there was a breach of contract.

"Water is a prime necessity and any act which would seek to deprive consumers of this essential element would be regarded as an unreasonable act on the part of the water company," declared Justice Dike.

"To carry out this threat this company would be endangering health and the possession of these numerous tenants who are the innocent parties to this controversy."

"There are certain considerations in the product of a water company which takes the dispensing of it out of the classification of private enterprise and gives it indeed a quasi-public character. Rules and regulations of course are necessary and proper to secure payment for the service given to the owners of property and for which they are obliged to pay, but all this involves the fee owner, it seems to me, as the responsible party and not the receiver, who is sought to be held responsible, for a claim which matured before he came into existence."

Justice Dike in upholding the receiver, pointed out that the question was of particular importance at the present time, because of the large number of foreclosure proceedings now pending.

If this sort of thing spreads, as seems very likely that it may at this time, water departments and water companies in cities have a new problem on their hands, and also more "red ink" to buy for their accounting departments.

There has been some consideration given to metering individual water services in large buildings in the same fashion that gas and electric services are already metered to individual tenants. There are arguments for and against the practicability of such a procedure but needless to say the precedent, established by the decision of Justice Dike in the Supreme Court of New York State, provides added support to the arguments advanced by proponents of individual apartment metering. To affect that, if at all practicable, would be at once a sound business procedure and a means of reducing the percapita water consumption—or better stated perhaps, it would reduce the per capita waste and make more certain the collection of water bills.

▼

Bankers and Bonds

MUNICIPAL financing problems and the difficulty of securing funds for public works betterments through marketing of bond issues should become a matter of past history with the passage of the Glass-Steagall bill just passed by Congress. The new law is designed to strengthen weak banks and in so doing is expected to bring back into American banks the vast amount of money withdrawn for safe keeping in safety-deposit boxes, under mattresses and elsewhere. Thus will funds become available from banks which are now unwilling if not unable to make further extension of credit, even on normally good and sound collateral.

The Glass-Steagall bill alters the provisions now governing the issue of Federal Reserve notes, permitting U. S. Government obligations to be used as collateral securing these notes and thereby will release gold above the 40 per cent minimum reserve. Scarcity of sound commercial paper has resulted in collaterating of a large amount of gold in recent times in excess of the minimum requirements and that will be released to serve as the required reserve against which new bank notes may be issued.

The Glass-Steagall bill provides also that any Federal Reserve Bank may make loans to a group of at least five member banks *on such collateral security as may be agreed upon.* In addition, for a period of a year, loans may be made to individual banks in exigent circumstances when they have exhausted all other means of obtaining funds. This provided that rates charged will be at least 1 per cent above the current discount rate and provided that loans are authorized by at least six members of the Federal Reserve Board. The effect will be a stimulation toward more liberal extension of credit. The measure is anti-deflationary rather than inflationary as early reports seemed to indicate it might be and the new law will work in the same general direction as is intended for the recently created Reconstructed Finance Corporation headed by Mr. Dawes.

Bonds of utility companies have recently been well bought on the theory that financing may be facilitated by lower interest rates, and Standard Statistics Company in its recently *"Financial Analysis"* says: "Purchase of selected bonds and retention of present holdings is deemed advisable. Not only are present yields decidedly attractive, but wide appreciation possibilities exist."

It would seem that the new law will do much in the way of enhancing the value of our banking system and improving the bond market. If it does, the financial clouds hanging over our municipalities will lift promptly. If it does not, nothing short of a governmental dole to municipalities will save some of our cities from absolute bankruptcy.

James H. Fuertes

JAMES HILLHOUSE FUERTES, Consulting Engineer and one of the foremost authorities on water supply and sanitation, died at the age of 68 at his home in Brooklyn, N. Y., on Jan. 30, 1932.

Mr. Fuertes was the son of the late Professor Estevan A. Fuertes, at one time head of the civil engineering department at Cornell University. He graduated from Cornell University with the degree of C. E. in 1883. He was associated with his father and the late Rudolph Hering on several projects. Since about 1895 he had maintained offices in New York for the practice of civil and hydraulic engineering.

He had been employed by many cities and towns throughout the United States and abroad. Some of these projects included reports on the water supply and sewerage of Santos, Brazil, and water supplies of New York City, Baltimore, and Philadelphia, the design and construction of water supply works for Harrisburg, Dallas, Denver, Cumberland, Lynchburg, Winnipeg, Steelton, etc. He was a member of the Metropolitan Sewerage Commission of New York City and designed and supervised sewage works for Hoboken, Hackensack, Elizabeth, Harrisburg, Dallas, Lebanon, Cumberland and elsewhere. In addition he maintained a varied practice in engineering. He was the author of "Water Filtration Works" and has written numerous articles on a variety of engineering subjects.

During the water filtration experiments at Harrisburg he developed the perforated pipe underdrain now so widely used in rapid sand filtration and known as the Harrisburg type. Anthracite coal as a filtering medium was an innovation introduced by Mr. Fuertes at Harrisburg and was later used at several plants constructed by him, notably at Dallas and Denver, and it is not improbable that coal may yet become a popular filtering material because of its low gravity and ease of washing at lower rates of wash water velocity than is required for the heavier silica sand.

Mr. Fuertes was an engineer of the highest professional ideals and practices. To him engineering was a true profession. He had a great capacity for attracting and holding friendships and was a source of inspiration to those associated with him. James H. Fuertes will live on as a guiding spirit to those who knew him.

L. H. Enslow

Glass-Overs for Sludge Beds

Lord & Burnham Co.

SLUDGE BED GLASS-OVERS

Graybar Bldg. New York | 208 S. LaSalle St. Chicago | Harbor Comm. Bldg. Toronto

Offices in Principal Cities

MARION, OHIO

Sewage Treatment Works

Floyd G. Brown
Sanitary Engineer in Charge

THE sewage treatment works at Marion, Ohio, were designed for a population of 40,000 persons.

Due to the fact that the plant effluent is discharged into the Little Scioto river, which is one of the sources of water supply for Columbus and which during dry weather has a flow of about 1.5 cubic feet per second, complete treatment of the Marion sewage was deemed necessary. The primary treatment consists of sedimentation in Imhoff tanks, and the secondary treatment consists of oxidation and clarification by trickling filters assisted by a set of final settling tanks. This was the first of the modern plants in Ohio to give complete treatment throughout the year.

The sludge drying beds are ten in number, each having an effective drying area of 17 x 74 feet, making a total drying bed area of 12,580 square feet. The depth of sand is twelve inches, overlying two inches of gravel and a six-inch tile drain with open joints. The entire sludge drying area is enclosed by glass of Lord and Burnham Standard Master Construction, thus making it possible to dry sludge at all seasons of the year.

THE WILLIAM LEN
CENTRALLY SITUATED AT MAIN & MONROE
RATES FROM $2.
NEWEST HOTEL IN MEMPHIS
250 ROOMS & BATHS
Coffee Shop Seating 300~Circulating ice water & fan in every room
OTHER SOUTHWEST HOTELS
MAJESTIC · · Hot Springs National Park, Arkansas
HOTEL MARION · · · · · Little Rock, Arkansas
HOTEL LA FAYETTE · · · · Little Rock, Arkansas
H. GRADY MANNING President

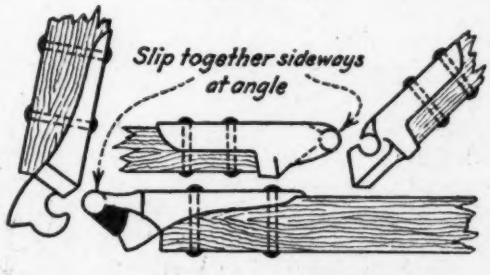
STEWART SEWER CLEANING MACHINE

Water Cleaning System, if you wish it, or Drag Bucket type.

WE WILL PAY FREIGHT AND CHARGE TO BILL.

We Ship Rods for Trial—who else will do this?

We also make a Rod that will float. Also rods with wheels for conduit work.



SEWER AND CONDUIT RODS

No Deep Shoulder Cut for Couplings. Rods retain full size and strength.

Investigate our JUMBO ROD

W. H. STEWART

1614 Locust Street . . . . . ST. LOUIS, MO.
129 George Street . . . . . BOSTON, MASS.
Box 581 . . . . . JACKSONVILLE, FLA.

CANADA FACTORY, WALKERVILLE, ONT.
Therefore No Duty for Purchaser to Pay

PACIFIC COAST DELIVERIES MADE FROM SAN FRANCISCO

Yes—we would like you to mention WATER WORKS AND SEWERAGE.

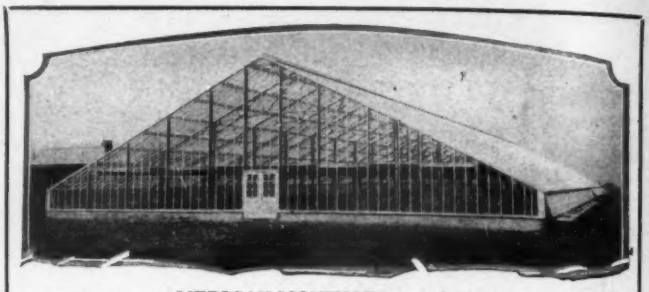
FILTER
SANDS AND GRAVELS

A HIGH GRADE SILICA PRODUCT MADE TO MEET YOUR SPECIFICATIONS

MENANTICO SAND & GRAVEL CO.

MILLVILLE NEW JERSEY

P. O. BOX 65



Since 1869 — AMERICAN-MONINGER sludge-bed covers are built of the all-steel-frame type of acid and fume-resisting construction and without interior posts.

Write for New Catalog describing glass sludge-bed enclosures

AMERICAN-MONINGER GREENHOUSE MFG. CORP.

1937 Flushing Avenue, Brooklyn, New York

Chicago, Illinois, 1313 W. Randolph Street — Amityville, L. I., N. Y., 124 Ketcham Avenue — Oklahoma City, Okla., 2611 North Dewey Street

A FILCLORATOR FOR

Assures the efficient operation of your gas control apparatus by delivering clean gas uninterruptedly to the metering orifices. Prevents clogging also necessity for blowing off tanks. Pays for itself. Circular on request.

WATER, SEWAGE, INDUSTRIAL PLANTS, SWIMMING POOLS

THE FILCLOR COMPANY

Commercial Trust Bldg.

Philadelphia Penna., U. S. A.

THE NATIONAL METHOD

of Water Main Cleaning

20 Years Experience

Write for Booklet

"The Cleaning of Water Mains"

National Water Main Cleaning Co.

32 Church St. New York

Dig In and Win

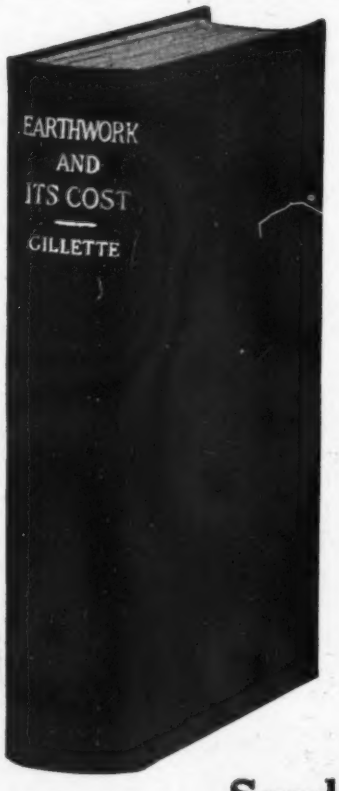
If your work involves excavation you know what a fertile field for loss this branch is, unless it is carefully estimated and executed.

We want you to benefit by the recorded experience gained on many jobs, and published for you in this clearly printed reliable book. Your profits will reflect this opportunity to stack your experience alongside the combined experience of others in this line.

The coupon tells how you can secure "Earthwork and Its Cost" for free examination. Read it; then send it. Read the book; then decide whether you will keep it.

Gillette Publishing Company

400 W. Madison St., Chicago, Ill.



Send this Coupon

This standard technical work by Halbert P. Gillette, is in its 3d Edition. It has 1346 pages. Pocket size, flexible, illustrated.

EARTHWORK AND ITS COST

Properties of Earth—Measurement, Classification and Cost Estimating—Boring and Sounding—Clearing and Grubbing—Loosening and Shoveling Earth—Spreading, and Rolling Earth—Hauling in Barrows, Carts, Wagons and Trucks—Methods and Costs with Elevating Graders and Wagon Loaders—Methods and Costs with Scraper and Graders—Methods and Costs with Cars—Methods and Costs with Steam and Electric Shovels—Methods and Costs with Grab Buckets and Dump Buckets—Methods and Costs with Cableways and Conveyors—Methods and Costs with Dragline Scrapers—Methods and Costs of Dredging—Methods and Costs of Trenching—Ditches and Canals—Hydraulic Excavation and Sluicing—Road and Railroad Embankments—Design and Construction of Earth Dams—Dikes and Levees—Slips and Slides.

Gillette Publishing Company
400 W. Madison St., Chicago, Ill.

Please send me postpaid for free examination the "Earthwork and Its Cost." In 10 days I agree to return the book or remit $6 in full payment and keep the book for my further profitable use.

Name_____

Company_____

Address_____

City and State_____

WW-3-32

SIMPLEX

Simplex Indicating Recording Totalizing Meter Register

Venturi Type Meters
Effluent Controllers
Filtration Plant Gauges
Water Works Specialties

•

WRITE FOR BULLETINS

SIMPLEX VALVE & METER CO.
6743 Upland Street
Philadelphia, Pa.

LAUGHLIN TRAVELLING SCREENS

MAGNETITE FILTER

and

MECHANICAL CHEMICAL TREATMENT

of

SEWAGE WATER AND INDUSTRIAL PRODUCTS

Developed and Controlled

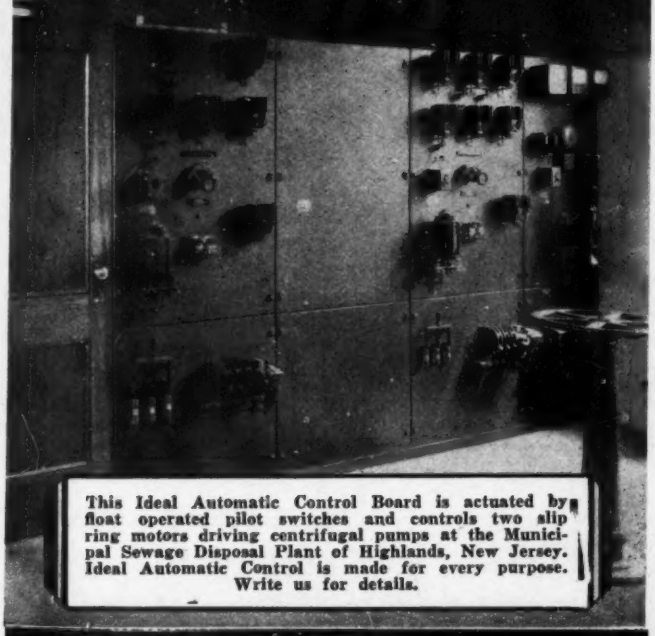
by the

FILTRATION EQUIPMENT CORP.

350 Madison Ave.

NEW YORK CITY

IDEAL CONTROL



This Ideal Automatic Control Board is actuated by float operated pilot switches and controls two slip ring motors driving centrifugal pumps at the Municipal Sewage Disposal Plant of Highlands, New Jersey. Ideal Automatic Control is made for every purpose. Write us for details.

The IDEAL ELECTRIC & Manufacturing Co., Mansfield, Ohio

SALES REPRESENTATIVES IN ALL THE PRINCIPAL CITIES

OMEGA presents two new products:

OMEGA **Precision Feeder** (Solution type) for small or medium quantities of any chemical.

OMEGA Takes the place of an expensive chlorinator. **Will feed "H T H," "Perchloron," Ammonium Sulphate, Activated Carbon, etc.**

OMEGA **Laboratory Stirrer** for tests on chemical dosage, coagulation, etc.

OMEGA also manufactures the well-known Omega Dry Chemical Feeders and Omega Lime Slakers in a wide range of capacities.

OMEGA has recently furnished chemical feeding equipment for water works plants at Detroit, Mich., Massillon, Ohio, Western Springs and Quincy, Ill., Ft. Worth, Tex., Thomasville, Ga., Newport News, Va., Kansas City, Kans., Oklahoma City, Okla., and many other cities.

OMEGA **MACHINE COMPANY,**
4010 Penn Ave., Kansas City, Mo.
Write for catalog.

Yes—we would like you to mention WATER WORKS AND SEWERAGE.

HANDBOOK OF CONSTRUCTION COST GILLETTE
HANDBOOK OF CONSTRUCTION EQUIPMENT DANA
MECHANICAL & ELECTRICAL COST DATA
COST DAT

the accumulated experience of many engineers, contractors and builders throughout the nation in—

The Methods and Costs Library

These 5 Books for Constant Reference

Volume I
Gillette's Handbook of Construction Cost
1734 Pages, 4½x7. Illustrated
Price $6

Volume II
Dana's
Handbook of Construction Equipment
New Second Edition
349 Pages, 4½x7. Illustrated
Price $6

Volume III
Gillette & Dana's
Handbook of Mechanical and Electrical Cost Data
Over 1500 pages, 4½x7. Illustrated
Price $6

Volume IV
Gillette's Handbook of Cost Data
1854 Pages, 4½x7. Illustrated
Price $6

Volume V
Connor's Labor Costs of Construction
200 Pages, 5x3¾
Price $3

Gillette's "Construction Cost Keeping and Management" standard treatise on organizing business for economy and profit; 572 pages. Without charge when you decide to keep the library.

This Book FREE

The value of this library can be fully realized in only one way,—at your elbow, accessible for reference as job succeeds job in your own experience. We know this from the reports of contractors and engineers who date the growth of their business prosperity from their first reference to these volumes.

Thus, we do not ask you to buy them first and learn their value afterward. We offer to put them at your elbow free of charge for a trial. Use them. Get the flavor of their helpful counsel. Check your own habits in figuring costs or selecting methods, in comparison with the general standard practice among builders everywhere.

After you skim through the broad subject headings at the right, send the coupon.

This List of Subjects Covered

Engineering Economics — Prices and Wages — Hauling — Excavation Economics — Standpipes — Concrete Construction — Dams — Reservoirs, and Water Works—Water Treatment Plants—Irrigation—Land Drainage — Sewers — Garbage Disposal — Roads and Pavements — Bridges and Culverts—Steam Railways and Tunnels — Docks and Wharves—Electric Motors — Lights —Miscellaneous Costs—Earth Excavation and Transportation—Rock Excavation—Steel Piling and Cofferdams—Wood and Concrete Piles—Concrete Costs—Concrete Form Costs — Steel Reinforcing — Structural Steel—Timber Work—Rough and Finish Carpenter Work—Brick and Tile—Masonry—Plastering and Plumbing — Painting — Sewers — Water Works—Concrete and Other Paving Costs—Equipment and General Labor Expense.

Gillette Publishing Company
Technical Publishers
400 W. Madison St.
Chicago, Illinois

Gillette Publishing Co.
400 W. Madison St., Chicago, Ill.

Please send the Methods and Costs Library, postpaid, for examination. In 10 days I will remit $6.90 in part payment and keep the books, or I will return them postpaid. If I keep them you agree to send me a free copy of "Cost Keeping and Management." I will send $4 a month for 5 months until the full price $26.90 is paid.

Name_____

Firm_____

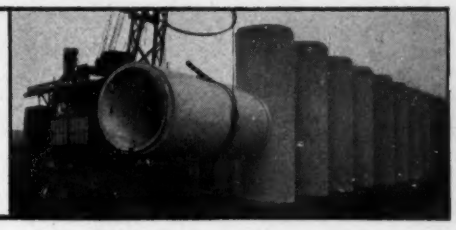
Address_____

City_____ State_____ WW-3-32

Books sent on approval in U. S. and Canada only.

$32.00 Library
with this coupon
$26.90

LOCK JOINT
Reinforced
Concrete Pipe
PRESSURE - SEWER - CULVERT
Lock-Joint Pipe Co., Ampere, N. J.



CLEARING HOUSE

POSITIONS VACANT

WANTED—MAN WITH TECHNICAL TRAINING to assist in research laboratory and actively engage in developing and effecting sales of a high grade technical product. One who has had some experience and a knowledge of Sanitary and Chemical Engineering preferred. Apply giving full particulars to Box 1000, Water Works and Sewerage, 400 West Madison St., Chicago, Illinois.

Steel Sheet Piling
New and Used
SOLD BOUGHT REPURCHASED
Stocks at principal points throughout the country for prompt shipment. We buy piling located anywhere.
HYMAN-MICHAELS CO.
St. Louis **CHICAGO** New York
Houston San Francisco Seattle

FILTRATION PURE
Silica **SAND** Washed and Dried
In Bulk or in Bags—Meets Specifications
Before Buying Write
Mines: Ottawa, Ill.
TAMMS SILICA CO. Chicago
228 N. LaSalle St. Chicago

SOUTH BEND FOUNDRY CO.
Adj. Curb Inlet
South Bend, Ind.

All Kinds of Gray Iron Castings
Patented Chilled Manhole Covers
Write for Catalog and Prices.
Made in 250 to 470 Pound Weights

News! The editorial columns provide you with new methods and practices in use by others in your field.
But the advertisements are no less important, for they keep you informed of advances in equipment and machinery that mean savings in construction costs.
READ THE ADVERTISEMENTS!

The 8 Gillette Periodicals

Trade and Technical Business Papers Affording Class Circulation in Highly Specialized Fields

1. ENGINEERING AND CONTRACTING
2. ROADS AND STREETS
3. WATER WORKS AND SEWERAGE
4. TILES AND TILE WORK
5. MOTIVE POWER
6. THE ART OF MOSAICS AND TERRAZZO
7. ROAD AND STREET CATALOG AND DATA BOOK
8. OIL AND SOAP

PUBLISHERS ALSO OF TECHNICAL BOOKS

The products of 28 years of cumulative editorial and publishing experience in the field of civil engineering.

GILLETTE PUBLISHING COMPANY

Established as Book Publishers, 1904
Established as Periodical Publishers, 1906

Chicago Daily News Building
400 West Madison Street
CHICAGO

DIRECTORY OF ENGINEERS

Alvord, Burdick & Howson

Engineers
John W. Alvord, Charles B. Burdick, Louis R. Howson, Donald H. Maxwell
Water Works, Water Purification, Flood Relief, Sewerage, Sewage Disposal, Drainage, Appraisals, Power Generation.
Civic Opera Building, Chicago.

Black & Veatch

Consulting Engineers
Sewerage, Sewage Disposal, Water Supply, Water Purification, Electric Lighting Power Plants, Valuations, Special Investigations, Reports and Laboratory.
E. B. Black, N. T. Veatch, Jr.
307 South Hill St., Los Angeles, California.
36 W. 44th St., New York City.
Kansas City, Mo., Mutual Bldg.

H. Burdett Cleveland

Consulting Sanitary Engineer
Water Supply and Purification, Sewerage and Sewage Disposal, Refuse Disposal, Treatment of Industrial Wastes, Design, Reports, Consultation, Investigation, Evaluation of Works, Supervision of Construction.
Transportation Building,
225 Broadway, New York.

Burns & McDonnell Engineering Co.

McDonnell-Smith-Baldwin-Lambert
Consulting Engineers
Waterworks Sewerage
Lighting Appraisals
Rate Investigations
Kansas City, Mo., Interstate Bldg.
Los Angeles, Cal.,
Western Pacific Building.

The J. N. Chester Engrs.

J. N. Chester
J. F. La Boon
D. E. Davis
J. T. Campbell
E. B. Bankson
Consulting Hydraulic, Sanitary and Valuation Engineers.
Pittsburgh, Pa., Clark Bldg.

Chicago Testing Laboratory, Inc.

and affiliated

Chicago Paving Laboratory, Inc.

Consulting and Inspecting Engineers
Hugh W. Skidmore, Gene Abson
Materials, Processes, Structures, Consultation, Inspection, Testing, Design, Research, Investigation and Experts in Litigation.
536 Lake Shore Drive, Chicago.

City-Wastes Disposal Co.

(Org. from Staff of Col. Geo. E. Waring, Jr.)
Consulting Engineers
Specialists in Drainage, Sewerage and Sewage Disposal.
Preliminary Investigations and Estimates, Surveys, Plans and Supervision.
Sanitary Examinations and Reports.
45 Seventh Ave., New York.

Clark, Wm. G.

Civil and Sanitary Engineer
Hydraulic, Sanitary and Municipal Engineering, Power Developments, Expert Examinations and Reports.
Toledo, Ohio, 1046 Spitzer Bldg.

Dow & Smith

Chemical Engineers
Consulting Paving Engineers
A. W. Dow, Ph. B., Mem. Am. Inst. Ch. Engrs.
F. P. Smith, Ph. B., Mem. Am. Soc. Civ. Engrs.
Asphalt, Bitumens, Paving, Hydraulic, Cement, Engineering Materials.
131-3 E. 23d St., New York City.

Fowler, Charles Evan

M. Am. Sec. C. E. M. Eng. Inst.
Can. Consulting Civil Engineer
Bridges, Foundations, Dredges, Dredging, River and Harbor Improvement.
New York City, 25 Church St

Gordon & Bulot

Engineers
Successors to Maury & Gordon
Water Supply and Purification, Sewerage and Sewage Disposal. Design.
Appraisals.
Reports.
Chicago, 53 W. Jackson Blvd.

Hall, B. M., & Sons

Civil, Mining and Hydraulic Engineers
Southern Water Powers.
Drainage.
Irrigation.
Atlanta, Ga., Peters Bldg.

Nicholas S. Hill, Jr.

Consulting Engineer
Water Supply, Sewage Disposal, Hydraulic Developments, Reports, Investigations, Valuations, Rates, Design, Construction, Operation, Management, Chemical and Biological Laboratories.
112 East 19th St., New York.

Kiersted, Wynkoop

Consulting Hydraulic and Sanitary Engineer
614 Interstate Building, Kansas City, Mo.
W Kiersted, Jr., Assoc.

A. Elliott Kimberly

Consulting Sanitary Engineer
Water Supply, Water Purification, Water Softening, Sewerage, Sewage Disposal, Sewage Treatment, Waste Treatment, Specialists in Milk and in Canning Waste Treatment.
1102 Atlas Building, Columbus, Ohio.

Morris Knowles, Inc.

Engineers
Water Supply and Purification, Sewerage and Sewage Disposal, Valuations, Laboratory, City Planning.
Pittsburgh, Pa.

Metcalf & Eddy

Engineers
Water, Sewage, Drainage, Refuse and Industrial Wastes Problems, Laboratory, Valuations.
Statler Building, Boston.

Neubling & Mast

Consulting Engineers
Emil L. Neubling, Member American Soc. C. E.
James E. Mast, Civil Engineer
Civil, Hydraulic and Municipal Engineering, Surveys, Appraisals, Investigations and Reports.
524 Court St., Reading, Pa.

Malcolm Pirnie

Engineer
Malcolm Pirnie, Charles F. Ruff
Water Supply, Treatment, Sewerage Reports, Plans, Estimates.
Supervision and Operation.
Valuation and Rates.
25 W. 43rd St., New York, N. Y.

Potter, Alexander, C. E.

Hydraulic Engineer and Sanitary Expert
Sewerage and Sewage Disposal, Water Supply and Purification.
New York, 50 Church Street.
Cortlandt 3195.

Randolph-Perkins Co.

Consulting Engineers for Water Supply and Distribution, Sewerage and Sewage Disposal.
Street Lighting Systems.
Zoning and City Planning.
Water Power Development.
Flood Protection.
Excavation Specialists.
Stripping Properties Prospected.
1446 First National Bank Bldg., Chicago.

Robinson & Steinman

Consulting Engineers
H. D. Robinson
D. B. Steinman
Bridges: Design, Construction, Strengthening, Investigation. Reports, Advisory Service.
117 Liberty St., New York City

Astrid S. Rosing, Inc.

Sewer Pipe.
Drain Tile.
Steam and Electric Conduits.
Building Tile.
Fire Brick.
3464 N. Clark St., Chicago, Il

P. H. Taylor Audit Co.

Municipal Accountants and Auditors
Audits.
Systems.
Budget Preparation.
Investigations.
267 Highland Ave., Buffalo, N. Y.

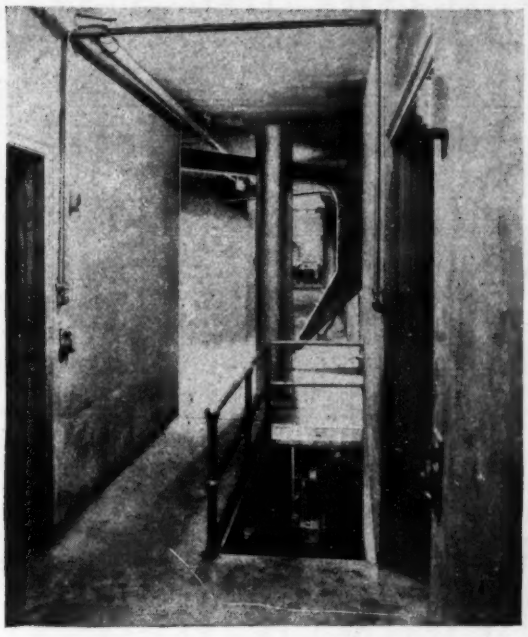
Waddell & Hardesty

Consulting Engineers
Steel and Reinforced Concrete Structures, Waddell's Vertical Lift Bridge, Difficult Foundations, Reports, Checking of Designs, Advisory Service and Appraisals.
150 Broadway, New York.

Yes—we would like you to mention WATER WORKS AND SEWERAGE.

A SEWAGE TREATMENT PLANT *UNDERGROUND!*

The only portions of the plant visible above ground are this small pump house and the hollow flag pole which serves as an exhaust vent. Sincerbeaux, Moore & Shinn, Boro Engineers. P. N. Daniels & Charles Capen, Jr., Consulting Engineers



The problem of building a sewage treatment plant in a desirable residential section and only a stone's-throw away from a bathing beach and large hotels has been worked out in an interesting and successful way at Spring Lake, N. J. A separate sludge digestion plant with a capacity of 1.2 m.g.d. was built underground. The plant has now been in operation for more than six months.

Dorr Equipment Used for Screening, Sedimentation, Sludge Digestion

Mechanical equipment in the plant includes a Dorrco Bar Screen, equipped with automatic control to regulate operation according to amount of screenings coming to the plant, 3 Dorr Clarifiers, Dorr Digester and 2 Dorrco Sludge Pumps . . . This plant is a fine example of the way in which modern sewage treatment processes can be adapted to the special requirements of different localities. Our engineers will be glad to furnish consulting engineers and municipal officials with information on the applications of Dorr equipment to various methods of sewage treatment.

DORRCO

Bulletin 6001

THE DORR COMPANY, INC.

ENGINEERS

247 PARK AVENUE, NEW YORK CITY

DENVER · CHICAGO · LOS ANGELES · WILKES-BARRE · ATLANTA · TORONTO

LONDON: The Dorr Company, Ltd. (Licensee)

BERLIN: Dorr Gesellschaft m. b. H. (Licensee)

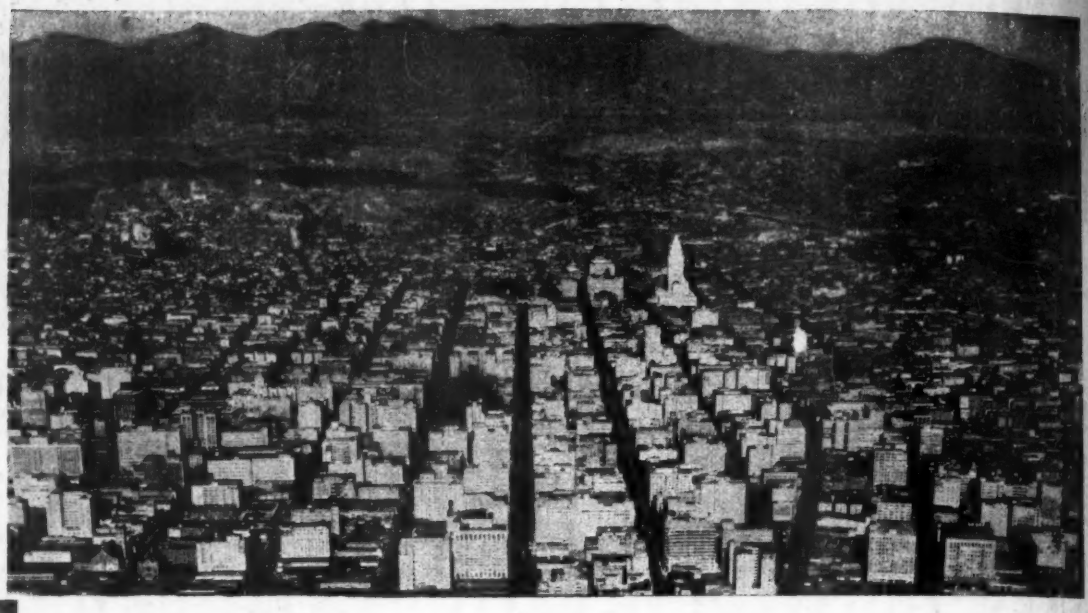
PARIS: Societe Dorr et Cie (Licensee)

MELBOURNE: Crossle & Duff Pty., Ltd.

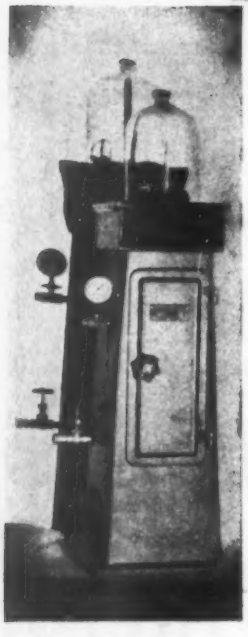
TOKYO: Andrews & George Co., Inc.

JOHANNESBURG: Edward L. Bateman, Pty., Ltd.

PURE WATER
. . . BUILDER OF CITIES



Selected as a camp site by Gaspar de Portola, August 1st, 1769, because of the available fresh water flowing down from the nearby San Gabriel foothills (named by Father Juan Crespi, the following day —the day of "Our Lady, Queen of the Angels"), Los Angeles owes its very existence to PURE WATER.



On the public and private swimming pools of Los Angeles, on sewage disposal plants and allied sanitary installations, 42 more W&T Chlorinators are giving this dependable service in Los Angeles today

LOS ANGELES *owes its existence to* PURE WATER

THE supply of water from the San Gabriel foothills is no longer adequate and Los Angeles spent millions to tap an available supply 260 miles distant.

And to maintain the purity of this water, all 14 divisions of the Los Angeles supply are today chlorinated entirely by W & T Vacuum Chlorinators—two-thirds of them fully automatic in operation.

On 22 occasions since 1923 Los Angeles has purchased W&T equipment —36 Vacuum Chlorinators in daily service give that same dependability, that same reliable service demonstrated three years ago when the St. Francis Dam went out. Of this, Dr. Carl Wilson, Director of Sanitation, says in "Western Water Works": "It is interesting to know that the lower San Fernandino plant on the Los Angeles Municipal Water System actually performed as planned by its designers when unprecedented floods created a condition of emergency". W & T Vacuum Automatic Chlorinators *automatically* and *adequately* chlorinated the greatly increased flow to avert the disaster of water borne disease.

Dependable chlorination can be yours, too, with the installation of W & T Vacuum Chlorinators.

Ask for your copy of Technical Publication 38

WALLACE & TIERNAN CO.

INCORPORATED

Manufacturers of Chlorine and Ammonia Control Apparatus

Newark, New Jersey — Branches in Principal Cities

Main Factory, BELLEVILLE, NEW JERSEY

"The Only Safe Water Is a Sterilized Water

SA-42

A GILLETTE PUBLICATION

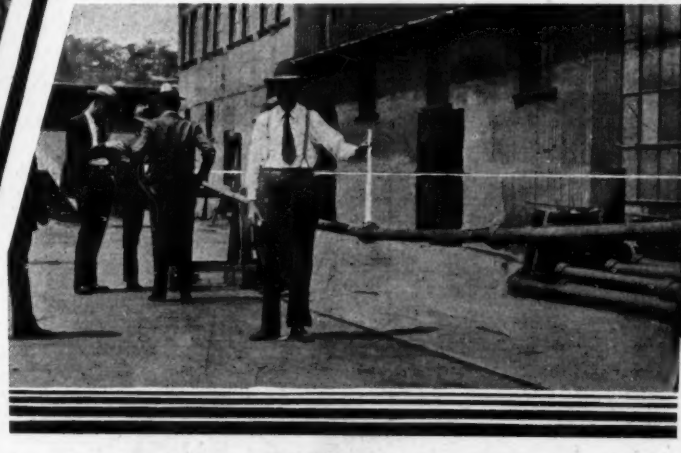
April, 1932 — Editor — Vol. LXXIX. No. 4

RESILIENT!

McWANE CAST IRON PIPE

2-inch McWane cast iron pipe *b-e-n-d-s.* Its 18-foot laying-lengths cut corners as well as costs for you. Resists rust. Long life distinguishes it. Tapping-collars permit "wet" taps. Various types of joints to speed and simplify laying. Sand-cast. Made as small as 1¼ inch, as large as 12 inch. Get McWane small-pipe booklet. Visit our exhibit at Memphis.

Above — "Job test": 2-inch McWane cast iron pipe rounding a curve without difficulty or fittings.



"Shop test": 2-in. McWane pipe deflected 12 14/16 inches in 36 feet under 90 lbs. air pressure.

McWANE CAST IRON PIPE CO. BIRMINGHAM ALABAMA

PACIFIC STATES CAST IRON PIPE CO. PROVO, UTAH

HTH

HTH
A Superior Product for Convenient and Accurate Preparation of Bleaching and Sterilizing Solutions
Stable — Readily Soluble — Uniform Concentrated
The HTH in this package contains 2½ lbs. Available Chlorine
Manufactured by
The Mathieson Alkali Works (Inc.)

"AN EXCELLENT AGENT FOR ALGAE AND SLIME CONTROL"

CITY WATER WORKS
City Hall
BLOOMINGTON, INDIANA

Nov. 20, 1931.

The Mathieson Alkali Works, Inc.,
250 Park Ave.,
New York, N. Y.

Gentlemen:

We have been using your product H T H for some time.

The other day we used it to sterilize a new 1,500,000 gallon reservoir. We obtained very satisfactory results at a very low cost.

We also keep H T H on hand as a standby supply of chlorine. It is used to sterilize all new pipe installations, and is an excellent agent for algae and slime control.

We will continue to use H T H in the future as we have in the past.

Yours very truly,

CITY WATER WORKS

By Kyl Dillman
Supt.

FCD:C

● HTH is a stable, dry, readily-soluble calcium hypochlorite, more than twice as concentrated as ordinary chlorinated lime. HTH does not lose its exceptionally high strength either in winter or summer...even during long periods of storage. Its use requires no special equipment and involves no returnable containers. HTH is shipped in cases of one dozen 4-lb. cans and HTH-Technical in 110-lb. drums.

NEW! HTH-15 is a new stable preparation of HTH *and soda base* containing 15% of available chlorine. Just add HTH-15 to water to get non-corrosive *sodium hypochlorite* solutions of dependable germicidal efficiency for all purposes of sanitation. HTH-15 is packed in handy 3-lb. cans, one dozen to the case. If your jobber or dealer cannot supply you, write us.

● It's easy to see why HTH is being
of other important applications in the
Works is typical. You can rest assu
rapid sand filters, condenser systems,
uniform and stable, is also being wid
lines, sludge drying beds and sewage
convenient form of chlorine will pre

The MATHIESON ALKALI WO

Soda Ash; Liquid Chlorine; Bicarbonate of Soda; HTH (Hypochlorite